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OF THE

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HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XXIII. JULY, 1886. No. 123.

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EXTRACT FROM THE BY-LAWS.

CHAPTER XII.

OF THE MAGELLANIC FUND.

SECTION 1. John Hyacinth de Magellan, in London, having in the year 1786 offered to the Society, as a donation, the sum of two hundred guineas, to be by them vested in a secure and permanent fund, to the end that the interest arising therefrom should be annually disposed of in premiums, to be adjudged by them to the author of the best discovery, or most useful invention, relating to Navigation, Astronomy, or Natural Philosophy (mere natural history only excepted); and the Society having accepted of the above donation, they hereby publish the conditions, prescribed by the donor and agreed to by the Society, upon which the said annual premiums will be awarded.

CONDITIONS OF THE MAGELLANIC PREMIUM.

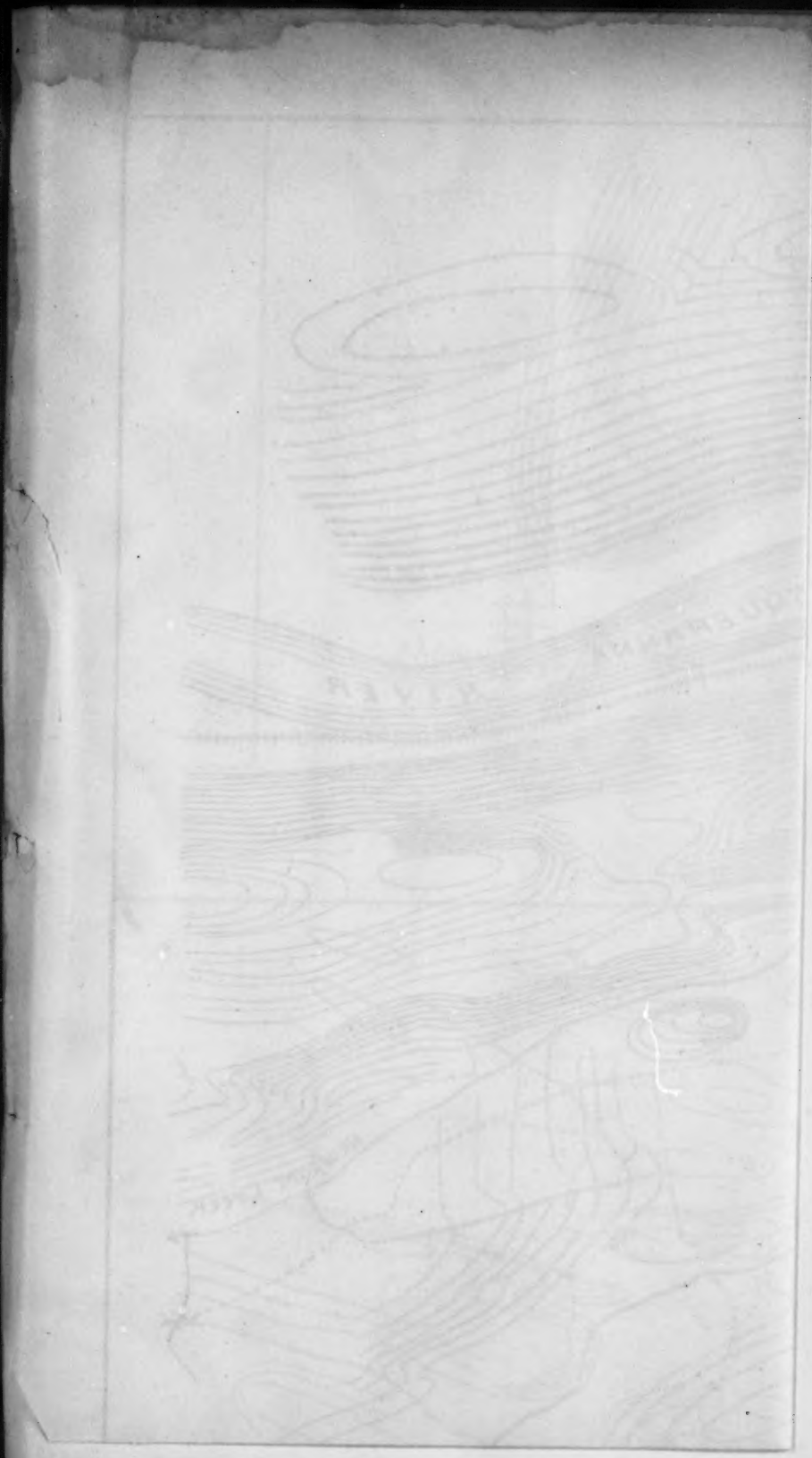
1. The candidate shall send his discovery, invention or improvement, addressed to the President, or one of the Vice-Presidents of the Society, free of postage or other charges; and shall distinguish his performance by some motto, device, or other signature, at his pleasure. Together with his discovery, invention, or improvement, he shall also send a sealed letter containing the same motto, device, or signature, and subscribed with the real name and place of residence of the author.

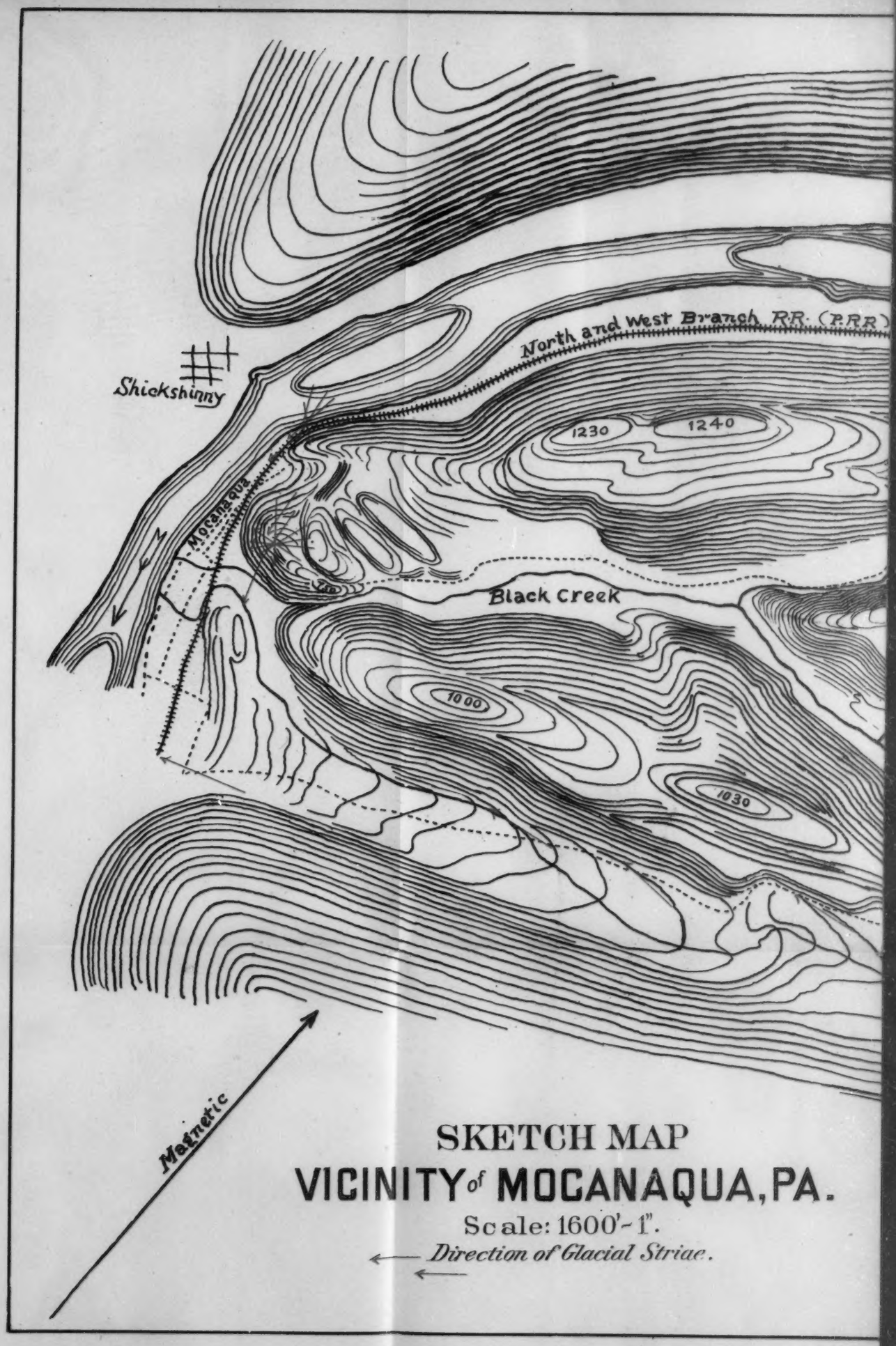
2. Persons of any nation, sect or denomination whatever, shall be admitted as candidates for this premium.

3. No discovery, invention or improvement shall be entitled to this premium, which hath been already published, or for which the author hath been publicly rewarded elsewhere.

4. The candidate shall communicate his discovery, invention or improvement, either in the English, French, German, or Latin language.

5. All such communications shall be publicly read or exhibited to the Society at some stated meeting, not less than one month previous to the day of adjudication, and shall at all times be open to the inspection of such members as shall desire it. But no member shall carry home with





SKETCH MAP
VICINITY of MOCANAQUA, PA.

Scale: 1600'-1".

Direction of Glacial Striae.

RR. (P.R.R)

SUSQUEHANNA RIVER

1140

1110

Newport Creek

Black Creek.

TURTLE RUN.

Mountain Inn

PA.

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The Glaciation of Parts of the Wyoming and Lackawanna Valleys. By John C. Branner, Ph. D.

(*Read before the American Philosophical Society, February 19, 1886.*)

PREFATORY.

It has long seemed to me that the careful study of limited glaciated areas would add some valuable information to our present knowledge of the subject of continental glaciation. By a limited area I mean one sufficiently large to have a varied and well-defined topography, when taken in connection with the surrounding country, and small enough to admit of thorough examination, and of a representation upon the map of details which cannot be admitted into maps of large areas without obscuring the subject instead of throwing light upon it. The Wyoming and Lackawanna valleys, with their bordering mountains, form such an area, and the work necessary to make of this region a topographical map of unusual detail gave me an excellent opportunity for making the necessary observations.

I have hesitated though about presenting observations that would be so much more valuable had they been extended, with the same care and detail, over a wider territory, and especially over the high lands that bound the valley to the north and north-west on one side, and to the east and south-east on the other; but as I shall, in all probability, have no opportunity for completing the work, and as all knowledge is cumulative, I offer these notes in the hope that others may be induced to add to them, and thus render them more valuable.

The glacial geology of this region is exceedingly varied and interesting. The Shickshinny end of the basin, on account of its bold and well-defined topography, is particularly so, especially in the study of the ice currents in their relation to topography. In studying the area under consideration, however, I have never lost sight of the fact that I was dealing with a very small portion of the glaciated part of the continent, and with localized parts, localized movements, and localized facts in a continental glacier.

Although the work done and the explanations offered here are entirely

original, I find that the influence of topography upon the movement of the ice was given, as an explanation of double striation, by Mr. C. E. Hall in the Proceedings of the American Philosophical Society, November 5, 1875 (pp. 633–4). The expression in this place of his theory upon the subject, is the most explicit I have seen. Prof. N. H. Winchell published an article in the *Popular Science Monthly* in 1873 upon "The Drift Deposits of the Northwest," in which he refers to the influence of valleys upon the edge of the ice. Mr. T. C. Chamberlin, in his "Terminal Moraine of the Second Glacial Epoch," refers in many places to the influence of topography on the direction of glaciers, and no doubt there are many other references to, and observations upon this subject which I have not been able to consult.

If, in recording the facts observed, I have been led to what may possibly be regarded as theorizing, my only defence is that it was quite impossible to see all about me the evidences of so wonderful, so awe-inspiring phenomena without coming to some conclusions regarding them. Then, too, in his letter transmitting Report Z of the Second Geological Survey of Pennsylvania, Professor Lesley has thrown no little doubt over the physical questions connected with glaciation, and, whether his suggestions there be open questions or not, they are calculated to make young geologists observe the evidences of glacial phenomena with a view to arriving at rational conclusions in regard to these questions.

The accompanying maps are necessarily upon a scale too small to convey a proper idea of the influence of the topography upon the movement of the ice. To show this a map would need to be very detailed and exact, and upon an unusually large scale, or better still, a large model would be required.

I take great pleasure in acknowledging here the kind encouragement of Professor Lesley and of Mr. Ashburner. To Mr. Geo. M. Lehman I am indebted for a number of valuable observations upon the direction of striæ in various places, and to Sheldon Reynolds, Esq., of Wilkes-Barre, for some observations made in the vicinity of that city.

Physical Features.

The Wyoming and Lackawanna valleys are, properly speaking, a single closed and curved synclinal valley, about fifty miles long by about five miles wide at its widest part, and bounded by mountains which coalesce at the extremities of the valley.

The concave side of its crescent form faces toward the north-west, the north-east end of the basin bearing about N. 20° E., and the south-west end bearing S. 70° W. Its mountain barriers thus presented themselves to the ice sheet at various angles, and now offer a valuable opportunity for observing the influence of such barriers upon the ice flow. Within this great basin are many secondary or miniature basins with a general resemblance to the large one, and many low, gently undulating and regularly sloping hills, some of which are anticlinals, and some are ridges

with steep sides and abrupt faces, the latter being somewhat characteristic of the south-west end of the basin, the former of the end north-east of Wilkes-Barre. These irregularities diversify the interior of the basin, and add beauty to its natural scenery, while, in some cases, they have produced marked effects in the glaciation and in the distribution of the drift material.

The Susquehanna river enters the basin at Pittston, passes out of it again at Nanticoke, and, flowing thence, parallel to its bordering mountains, to Shickshinny, it here cuts square across the end of the basin. The north-eastern end of the basin is traversed by the Lackawanna from above Forest City to Pittston, where it flows into the Susquehanna. In the end of the valley north-east of Scranton there is a striking parallelism of the larger streams that run into the Lackawanna, and, inasmuch as it has been thought that this parallelism was due to drift deposits, I shall give here what appears to be its explanation. The streams referred to run in one of two general directions, which form an angle of about 77° with each other. The first of these is followed by the upper part of Eddy creek, Von Storch's creek, etc., and by the Lackawanna from where it bends, below Archbald, to Olyphant. It should be noted that these streams are parallel with the axes of the anticlinals in this part of the coal basin. The second direction is followed by the Lackawanna from Jermyn to the bend below Archbald, and by Fall brook, Coal brook, Elk creek, etc. None of these streams are in the drift, but in the solid rock, or rather, they flow between well defined hills of solid rock, and their courses have been determined largely, if not entirely, by the jointed structure of the rocks, possibly by faults in some instances.

The south-western end of the basin is crossed by a water-shed that drains it in two directions. The Nanticoke and Mocanaqua road crosses this water-shed about two and a half miles above the latter place, and about a quarter of a mile west of Uplinger's. On the northern side of the road this water-shed reaches the top of the river mountain in a north-westerly course. On the south side of the road it runs nearly half a mile south, when it turns east, and keeps this general direction for nearly two miles; then turning south again, it crosses the Mountain Inn road, just three-quarters of a mile above the Mountain Inn. Here it turns east, and in this bearing reaches the top of the Little Wilkes-Barre mountain. The lowest elevation, or gap, in this water-shed is on the south side of the axis of the coal basin, and a little more than half a mile north of the old Mountain Inn. According to Rothwell's map of this region, this gap is about 375′ above the Susquehanna at the Nanticoke dam. The lowest point in the water-shed next after this one, is near where it is crossed by the river mountain road at Uplinger's, and not far from the axis of the basin. This gap, according to the same authority, is about 415′ above the water at the Nanticoke dam. To the south and west of this water-shed the water reaches the Susquehanna just below Mocanaqua through Black creek and Turtle run. To the north and east it drains into the Susque-

hanna at Nanticoke through Newport creek and its tributaries. These streams, especially two of the largest of them, have, at some time in the past, borne an important part in the transportation, modification and rearrangement of the drift material. Their influence at present, however, is very insignificant as compared with what it doubtless was as the glacial epoch drew to a close.

The Surface Rocks.

The exposed or surface rocks of this region include the Carboniferous shales and sandstones, some of them easily decomposed, the Pottsville conglomerate, the sub-carboniferous red shales, and the Pocono sandstones, while the Catskill shales and sandstones lie just beyond the border of the basin. The Carboniferous shales are of various degrees of hardness and resistance, spots here and there preserving the striæ remarkably well, while in other places the same beds have disintegrated two inches or more below the polished surfaces that remain.*

Many of the sandstones have decomposed so rapidly that it is a very common thing to find surfaces that were once rounded, smoothed and striated in the characteristic way, now preserving not a single line that can be identified beyond doubt. But in some places, where these same sandstones have been protected by a considerable layer—say two feet or more—of drift, and only recently uncovered, the striæ are still well preserved.

As a rule, the Pottsville conglomerate preserves its ice record most faithfully, and frequently, too, under adverse circumstances. Cropping out around the border of the coal basin, and just inside of the mountains that limit the valley, this formation lies a little below the crest of these ranges, forming a continuous shoulder where the disintegration of the softer rocks, both above and below, has exposed it to the weather along the greater part of its outcrop. In many places this exposed rim has been so thoroughly polished that it is next to impossible to determine the direction of the striation. Indeed not a few of these highly polished rocks had to be passed over, especially during the early part of my observations, without my being able to detect a single well defined line, and not until my work was about drawing to a close did I hit upon a method for detecting the markings upon such surfaces.†

*I would not be understood as implying here that two inches represent the total general erosion that has taken place in this region since the glacial epoch. In such places as the one referred to, the surfaces are comparatively well preserved, while there are others in which the rocks have flaked off to the depth of many inches, or even feet, by the action of frost, and from which, of course, all evidences of glaciation have long since disappeared.

†A thin covering of soil sometimes permits a slow disintegration of the conglomerate, which leaves a few of the quartz pebbles in their original position, fast in the body of the rock, with their upper parts cut away and polished by glacial action. Examination of these polished pebbles, under a lens of low power, may show minute striæ, but it more frequently happens that these

The Mauch Chunk red shales are wanting about the north-east end of the basin, but they form thick beds in the Shickshinny end. When uncovered and exposed to the action of air, water and frost, these rocks have gone to pieces rapidly, but they have preserved the striation remarkably well wherever they have been covered up by a considerable thickness of earth. Striation on these shales therefore, as indeed upon most of the rocks, is only found along the roads and cuts where they have been recently uncovered.

The Pocono sandstones, forming the crests of the mountains on both sides of the valley, lie, for the most part, in a desolate, uncultivated, uninhabited and untraveled region, in which but few striated exposures are to be found. This is particularly unfortunate, for we must, of course, look to the markings upon these high points for the indications of the direction of the ice sheet when it had attained its grandest proportions, and before its margin was here reduced to the condition of local glaciers. This formation is the limit of my observations on the glaciation of this region.

Striation; its Indications of Flow, Change and Wear.

Scarcely a place can be found in the valley, which, if the rocks have been protected from the weather by a covering of earth, does not retain some signs of wearing by ice. Where the rocks have been long exposed to the action of air and water the well defined lines have, for the most part, been defaced. But even in these cases, the rounded faces of the rocks are often still preserved. But though the striæ are, in all probability, well preserved over almost the whole of this region, the drift and soil, covered, for the most part, with forest and undergrowth, render it impossible to make the record as complete as desirable. Most of the observations made upon the direction of the striæ have been placed upon the accompanying maps, and it is unnecessary to speak of them in detail. Some of the observations have been omitted in cases where several similar ones were made too near each other to warrant drawing several arrows upon the map parallel to the first one. Where there are two or

markings cannot be detected. I found that by gently rubbing a hard (6 H) pencil across the worn surfaces until they were quite covered with the lead, the fine striæ would stand out as white lines. Mr. George M. Lehman of the Survey, who has rendered me valuable assistance by noting the striation in places that I did not visit personally, also found that on a large polished surface, the lines could be detected by the observer taking such a position that the sun would be reflected from it to his eyes. It is necessary in this case, however, that the plane of incidence and reflection should be parallel with the direction of the striæ. I have found this method a useful one, though it is open to the objection that one cannot always have the sun in the desired position. This difficulty may be obviated by making the observations at night, and using a lantern for the reflections. When good exposures, sufficiently close to each other, can be had, it is not necessary that so much pains be taken to get an observation, but it not infrequently happens that it is very desirable to have one in some particular spot, and where the nature of the rock and the striæ require some such methods as the ones mentioned.

more sets of striæ in one place, they are represented by the arrows crossing each other at the proper angle. In a few instances the change in the direction of the striæ, either in the same place, or in places not far removed from each other, has been so great that it might well be asked upon what grounds I conclude that the flow of the ice was in the direction represented, and not exactly in the opposite direction. In such cases I have depended upon the topographical features and the nature of the scratches to settle the question—the lines frequently deepening in the direction of the movement of the ice—and, as far as I am able to see, the results have been satisfactory, though sometimes striking.

The striæ themselves are of the usual character, modified by the rocks upon which they occur. Those on the harder sandstones and conglomerates are shallow, and frequently so fine as to produce a high polish, while those upon the shales and softer sandstones are well defined and deep. They are approximately parallel to each other, though often crossed by other parallel sets of striæ pointing in different directions. Individual marks frequently deepen toward the south, and end in a deep gouge. Instances occur of what were at first considered to be glacial grooves, but, upon further and more careful study, these grooves were always found to be channels in the rocks, polished and more or less modified by ice. In one instance the impression of the trunk of a large Lepidodendron, lying in the direction of striation, had been worn out so smoothly that it was for some time mistaken for a glacial groove. The best defined striæ are found where the glacier moved along upward, horizontal, or gently downward gradients, and least prominent upon the steeper faces of hills that slope in the direction in which the ice moved. Evidences of "upward flow" are quite abundant, and where two or more sets of striæ occur in such a place, those pointing upward are frequently, though not always, the deepest. Furthermore, where the striæ indicate an upward movement the glacier appears to have moved forward with little or no regard to the smaller details of topographical features. I would emphasize these *smaller details* in this connection, for they had their share of influence later, as I hope to show.

The explanation of this upward movement and of these variations in the direction of the ice stream must be sought in the topography of the region and the varying thickness of the ice; indeed, unless these matters be taken into consideration, such phenomena are utterly meaningless. In the conglomerate ledge east of Carbondale are a great many depressions, or shallow holes, across which the ice has moved, to all appearances, without being impeded or deflected perceptibly from its general course. These depressions are of various sizes and depths, many of them being from a few inches to two or three feet wide and one or two inches deep. Such inequalities in the surface of the rock are not uncommon all through the region under consideration, and they are doubtless to be found in all glaciated countries. No one appears to be surprised that the ice should move down one side of these shallow depressions and up the other, and when

the rim of the depression is a thousand feet, or more, above the bottom, why should not the same physical law hold good? It certainly does, to all appearances. But while ice only a few feet in thickness might flow across an inequality in its rock floor one or two inches deep, it would require a sheet proportionally thick to cross a valley like the Wyoming and Lackawanna without being deflected. And whenever varying sets of striæ in high altitudes were found, they go to show that, when the ice was at its greatest thickness, it moved across this valley without being turned from its general course, influenced only by the continental topography, in comparison with which the bordering ridges of the valley were insignificant, and scoring the evidences of its course deeply in the rocks. In other words, the only topography ignored by a continental glacier is that of local details. As the ice-sheet grew thinner, these mountains—the topographical details—influenced its course more and more, until it was reduced to the condition of local glaciers along its retreating southern margin.

The author of Report Z of the Second Geological Survey of Pennsylvania refers to "upper striæ" and "lower striæ" (Z, p. 106), and appears to think that the latter were made by under-currents in the ice, while he explains the different sets, when found together, by referring some of them to a sort of land-slides, which are said to produce "creep striæ" (Z, p. 84).

I have found no evidences in the region under consideration of striæ having been produced otherwise than by ice moving as a glacier. That some of them, indeed all of them, were produced by masses moved by "gravity" (Z, p. 85) is quite admissible, inasmuch as gravity is the force which causes the ice of all glaciers to move, and is as accountable for its moving down a great general or continental incline with surface irregularities a thousand feet deep, as over a limited one having depressions only an inch deep.

Many instances might be mentioned of a variation in the direction of the ice current, caused by little irregularities in the surface of the bed rock, without the glacier becoming localized. These are doubtless glacial under-currents. Evidences of this kind of a current are to be seen above Dunmore, at the quarry near the head of Plane No. 7. Here, a block of conglomerate having been removed from the wall of rock, the ice in the bottom of the glacier was caught beneath and below the projecting ledge, and forced forward and upward at an angle which I did not measure, but which, as nearly as I can remember, is about fifteen or twenty degrees. The horizontal bearing of these striæ is S. 40° E., while immediately above, on top of the ledge, and ten feet away, the striæ point S. 10° W.

Another interesting example of this character is found on Kelly's island in Lake Erie, and is described by Charles Whittlesey in vol. xxvii of the Proceedings of the A. A. A. S., pp. 239–245. It is also well figured by Chamberlin in his "Preliminary Paper on the Terminal Moraine of the Second Glacial Epoch."* But the existence of such diminutive under-

* Third Annual Report of the U. S. Geol. Survey, p. 336.

currents can hardly be regarded as evidence that there was an under-current filling and flowing down the Wyoming valley, while another upper-current flowed over the tops of the mountains. The existence of different sets of striæ in the same place, pointing one set across the mountain, and another down the valley, make such a theory unnecessary at least. Evidence that there were no great or extensive undercurrents in the ice may be seen in the gap through which the Lackawanna runs at Archbald. Just above the village, where the track of the D. & H. Gravity railway track crosses the old plank road, the striæ show beyond question that the ice in passing through this gap was not deflected by the topography into undercurrents, but that it was pushed straight ahead, and when there was not room for it in the narrow gorge, it was forced obliquely up and over the steep side of the hill, while the main body of the ice moved square across the hill that here stands out across the valley. If it had been moving in currents, it would have gone around the end of the hill, and the striæ would converge in the narrowest part of the gorge.

Again, at Mocanaqua, a quarter of a mile from the bridge, up the railway track, the striæ on the red shale point up the side of the steep hill at an angle of at least 30°, showing that the ice at the side of this gap flowed straight forward and up the hillside, instead of turning as an undercurrent and going down the channel as water would have done.

Just east of Mocanaqua, on the top of the hill above the West End breaker, a few hundred feet from it, and near the side of the road, are exposures of striæ with the following bearings:

S. 30° E.
S. 25° E.
Due South.
S. 45° W.
S. 65° W.
Due West.

Those pointing S. 30° E. and S. 25° E. appear to be the oldest of the ones now preserved, while those pointing due south predominate. It seems probable therefore that the oldest striæ were made when the ice came over the Shickshinny mountains, and when it was thick enough to disregard such a topographical feature. As the ice became thinner it ran due south, the later striæ almost obliterating those previously made. Further thinning of the ice sheet subjected it more and more to local influences until nothing was left here but a thin and narrow body of ice that came down the valley of Black creek, and being turned by the conglomerate ledge, left these last faint striæ that point west over the edge of the precipice.

In the Lackawanna end of the valley are several cases of double sets* of

*Striæ sometimes cross each other at well-defined angles without occuring in sets. Such variations may possibly have been caused by the cutting material having been turned in the grasp of the ice. No account was taken of striæ of this character.

striæ. One of these exposures is near the village of Jessup, on the hillside between Dolph's drift and its air shaft. Here they point due south, S. 25° W., and S. 30° W. Where there are several sets of striæ it is not always easy, and indeed it is sometimes quite impossible, to determine, by the striæ alone, which of the sets is the oldest. In this case, those pointing south appear to be the oldest, from which it is to be inferred that they were made when the ice was least influenced by the hills to the south, and that those veering to the west were made when the thinner ice began to feel the influence of the topography. In both cases the movement of the ice was up the side of the mountain. Another case of double striation was found above the track of the Erie and Wyoming railway, and about 1500 feet above the Scranton reservoir on Roaring brook. At this place one set points due south, while the other points S. 15° W. It was impossible to determine which of these sets was the older, though the striæ pointing south were the more numerous.

At the Nanticoke gap is a striking instance of local topographical influence upon the glacier. Near the mill-pond on the south side of the Susquehanna, and on the low ground, the striæ point N. 70° W., and on the north side of the river, near the railway station, they point N. 80° W. and due west. On top of the conglomerate ledge that rises above Nanticoke, near the gap, and just south of the river, the striæ point south, from five to twenty degrees east. Within a mile of each other horizontally, and five hundred feet vertically, these two sets of striæ differ in their bearing by 130°. Directly north of those on top of the conglomerate and at the foot of the steep ridge, Mr. Lehman informs me, the striæ are parallel with the river. The explanation of these contrasts in the direction of the striation is naturally suggested by the bold and well-defined topography of this region. The earlier ice probably moved nearly south across these ridges, while the localized glacier followed the depressions of the valley and, a part of it, at least, flowed through the Nanticoke gap and down the present channel of the Susquehanna river.

The south pointing striæ on the mountain west of Nanticoke contrast strongly with those on the top of the same ledge near Mocanaqua.

It will be noticed that where the water-shed from across the basin reaches the top of this mountain the striæ are parallel with the ridge. When they occur below the crest of the ridge, they are, doubtless, due to the ice moving down the deep, narrow valley, now occupied by the Susquehanna river. The explanation of the direction of those near Nanticoke must be sought in the topography to the north of where they are found.

The topography of the surface of the great glacier itself probably had its influence in directing the movements of the ice. If we imagine a perfectly even surface with the ice flowing across it, and a deep gap or notch made in the margin of the ice, it is evident that the tendency would be for the ice to flow toward this gap from both sides, while an ice promonotory between two such gaps would move along lines having a palmate radiation.

Mr. Chamberlin has happily represented the glaciers of the second epoch as moving in this manner. I would suggest that the scratches referred to on pp. xxi and xxii of Report Z may have been varied by such means, if the topography itself of the region cannot account for the change.

The glacial striæ, wherever observed in this valley or along its borders, seem, in every instance, to prove :—

1st. That the glacier, when at its greatest thickness, was influenced only by the great average topographical features of the glaciated region, and, consequently, that what appears to have been the upward movement of the ice is upward only in a local sense.

2d. That as the ice-sheet began to grow thinner and to retreat, its southern margin came more and more under the influence of local topography, and ended in local glaciers.

3d. That when more than one set of striæ are found in the same place, they are due to the direction of the thinning ice having been changed by topography.

Wearing Power.

The variation in the direction of striation in the case above the West End breaker at Mocanaqua amounts to 120°, without the original (?) striæ being obliterated. Other instances of double striation have also been referred to. I was at first inclined to think that such cases might be taken as conclusive evidence of the small wearing power of ice. But such a conclusion would evidently be unwarranted, for, whatever the original wearing power of the ice may have been, that power certainly diminished as the ice grew thinner and the glacier retreated. The later striæ cannot fairly, therefore, be taken to represent the wearing power of the ice when it was thickest. Indeed it is quite evident, from almost any one of the cases found, that the furrows made by the ice when thickest, were very deep, while later ones were so shallow as to fail to entirely obliterate the former ones. Furthermore, we have no means of knowing the comparative length of time the ice was moving in the different directions recorded. It may have moved for a long period in the direction indicated by the oldest of the preserved striæ, and, so moving, may have worn what the most extravagant claim for it (at least as far as any evidence to the contrary, found in this region, is concerned) ; while motion in the other directions may have been only of long enough duration to leave the markings we now see upon the rocks.

The Drift, its Character, Origin, Distribution and Arrangement.

The material composing the drift found through this region appears to be almost entirely local. In no instance did I find a single boulder of granite, or of any other archæan rock, though I watched carefully for such specimens. Only along the Susquehanna river did I find a few pebbles of archæan origin, but these were so small and water-worn that I am obliged

to believe they were brought down by the river from the glaciated regions lying farther north, rather than by the ice. Even fragments from the Catskill shales cannot be regarded as very common, when compared with those from the Pocono sandstone, the Pottsville conglomerate, and the carboniferous shales, sandstones and coal. Especially is this true of the Lackawanna end of the valley north-east of Scranton. In a cut about forty feet deep, where the Winton Branch of the D. L. & W. railway passes through the drift near Eddy creek, many fragments of the reddish shales and sandstones of the Catskill may be seen. Judging by the lithological characters of these fragments, and by the direction of striation, they probably came from the tops of the hills just south of the Susquehanna County line, near Crystal Lake, in which case they must have traveled at least fifteen miles.

The character of the arrangement of the material changes with its elevation. That in the deeper parts of the valley is generally water-worn, and shows, by its being assorted and more or less stratified, that it was deposited in, or frequently washed by water. Kames of this material are, in some cases, nearly or quite a hundred feet in height. Higher up the sides of the valley no regular arrangement of the material appears, and the fragments that lie heaped in many of the hollows are rough and angular, and bear no signs of having been worn in a glacier, but appear to have been transported upon its surface. Of the latter kind of drift there is comparatively but little, while the former kind appears to have originally filled the deeper depressions along the trough of the valley. Here, the streams, seeking their natural channels, have washed away much of the original drift, and spread it out over the flood plains and alluvial lands down stream, leaving our present kames for the most part lying along the foot of the hills. In the upper or north-eastern end of the valley there are comparatively few kames, and these are generally of coarser material, while toward the lower end of the valley, below Scranton, they are more abundant, and have more sand and fine material in them.

The valley of the Lackawanna above Carbondale is so narrow, and the fall of the stream so rapid, that but little drift now remains along its course from the gap through which it enters the coal basin above Forest City to Morss' tannery near Carbondale. Below this point the bottom of the valley is restricted at several points, so as to form a series of dams, or, more properly speaking, of narrows, which have acted as dams to spread the floods of post glacial times out over low lands, or flats, immediately above them. The first of these dams below Carbondale appears to have been caused by the proximity of the drift on the south-east side of the valley to the little hill on the north-west side, at the base of which the bridge of the common road now crosses the Lackawanna in the town of Jermyn.*

In this case the dam may have been at or near where Rush brook now

*The dams in this part of the valley do not appear to have been as well defined as some of them further down the river.

enters the Lackawanna, or it may have been in the gorge above Archbald. In the latter case the narrowness of the valley between Jermyn and Archbald would not admit of a widespread deposit of silt, while the rapid descent of the stream must have combined with this narrowness to cause the washing away of nearly all the sediment that was thrown down between these two places. The rather unusual deposit of large quantities of drift on the east side of the river below the Archbald gorge may have been carried down from this narrow valley. This material, composed for the most part of large cobble-stones, and with but little sand and gravel in it, once filled the lower part of the Laurel Run hollow. But this stream has gradually cut it away, until its southern face is now a steep bank from ten to thirty feet high. Below Archbald the valley is narrow, and the current rapid, as far as Peckville. The next dam appears to have been at Olyphant. Here the flood plain of the valley narrows very considerably, the rocky hill upon which part of the town is built standing out from the south-east side across the valley, and thus confining the river to a comparatively narrow channel. The damming back of the floods here probably helped to form what are now the meadow lands between Olyphant and Peckville.

Following down stream, the next case of this kind appears to have been at Scranton. The city of Scranton is built upon a wide terrace of glacial drift, which, possibly, closes now the original channel of the Lackawanna river at this place. Opposite this terrace the hill upon which Hyde Park is built stands out across the valley, leaving a channel only about three hundred feet wide between the two, and through which the Lackawanna now flows. At or near the close of the glacial epoch, the drift must have dammed up the channel in this narrow neck almost entirely, and the muddy waters that have poured down this valley since the retreat of the ice, spreading out over the flats, have precipitated and deposited upon them the sand, silt, and alluvium of which they are formed. But as the river gradually descended to its present bed, it cut away the western side of the Scranton terrace, until it left its edge the abrupt, high bank along which Mifflin avenue now runs.

It is particularly true of this, the north-eastern, end of the valley, that the drift has been left, for the most part, along the foot of the hills. On the north-western side, along the old plank road, these kames may be seen all the way from Providence to Winton, cut through by the streams flowing down the sides of the mountain. On the opposite side of the valley they are not so well exposed, and are, for the most part, overgrown with forest; but the drift is even deeper and more widespread on this, than on the north-west side.

The influence of the drift upon the course of the streams in this region has not been so marked as it would have been in a flatter country, the courses of only a few of the smaller ones having been determined by it.*

*The change in the bed of the Susquehanna between Pittston and Kingston is referred to elsewhere.

Drift in the South-west End of the Valley.

Having had no opportunity for examining the drift between Scranton and Wilkes-Barre, I shall pass over this part of the valley, and speak of its south-western extremity.

The great body of the drift in this end of the valley, especially between Nanticoke and the water-shed that crosses it two and a half miles above Mocanaqua, lies below the elevation of the gap in the water-shed. Most of this drift is assorted. The largest and most interesting kames in the whole valley, as might have been expected, are found in the vicinity of Nanticoke.* Two of these were cut into in making the Newport colliery branch of the Susquehanna Coal Company's railway, one opposite the bridge of the Lehigh and Susquehanna railway over Newport creek, the other three-quarters of a mile further up Newport creek. The horizontal stratification of the material forming the kames south-west of Naticoke, and particularly those about the Newport colliery, show an absence of any strong current in the waters by and in which it was deposited. The sand of these kames shows, by the presence of much coal in it, that a large part of the material is near its original source. Here may also be seen good examples of distorted bands or strata of sand lying between straight or horizontal ones.

The distribution of assorted drift throughout this end of the basin, from Nanticoke to the gaps in the water-shed, seems to show that the water was once backed into this space by a dam, or gorge, in the Susquehanna at, or below the Naticoke water gap. The topography and the disposition of the drift also, indicate that the water was backed into this end of the basin, and that some of it, at least, flowed over the water-shed at the gaps already mentioned, and reached the river below Mocanaqua, by the way of Black creek and Turtle run. The valley through which Black creek runs is too narrow, and its fall too great to permit the accumulation of much drift along the stream, and as a matter of fact but little has been left along it above where it passes the conglomerate ledge. Below the ledge and between the West End breaker, and where the Mountain Inn road turns off to the east, are some very large kames.

Kettle-holes.

But few kettle-holes have been observed, and it is probable that the narrowness of the valley through which the glacial floods were obliged to pass has caused most of them to be filled up or otherwise obliterated. The half dozen observed are all small. One of them is in the town of Jermyn, just north of the school-house, and is now partly filled with water. Another smaller one is south of, and about a thousand feet from the residence of Mr. Richmond, of Richmond Hill farm, near Providence. Three

* In making this statement it is possible that I should make an exception of the kames in the vicinity of Pittston, which I have had no opportunity of examining.

others are on the water-shed near Uplinger's, in the south-west end of the basin. They are in the fields near the road, and are visible from it. The largest of these is nearly round in outline, from ten to fifteen feet deep, and about seventy-five feet wide. The smallest one is oval, and about twenty-five feet wide, while the intermediate one lies nearest the road and is pear-shaped in outline.

Boulders.

Large boulders are common throughout the valley, but especially so along the sides and top of the mountain that bounds the south-eastern side of the basin. They are generally of Pottsville conglomerate, and have been brought, at farthest, only across from the outcrop of this formation along the north-western rim, and left stranded where they now stand. Most of them are angular, and show few or no signs of glacial wearing. The largest seen by the writer are grouped together two and three-quarter miles due south-east of Peckville, but within the outcrop of the conglomerate, on the side of the basin. They are about $8' \times 10' \times 10'$, some larger and some smaller. Judging from their thickness and general appearance, their position and the course of the ice hereabout, they appear to have been carried up hill from the outcrop of conglomerate along the edge of a small valley about a thousand feet to the north-east of where they now stand. Smaller boulders, both of conglomerate and Pocono sandstone, are also widely distributed in this region, while they are especially common in some of the little hollows that head high up the sides of the mountains on the east. Here they lie heaped together promiscuously. These fragments are also local, and generally angular, being but little worn, or not worn at all, as if they had been brought here upon the surface of the ice. When boulders are found heaped together in this way lower down in the valley, they are invariably worn by ice, or water, or both. A striking example of this kind is exposed in the shallow cut along a branch of the Delaware, Lackawanna and Western railway where it runs in toward Dolph's breaker, near Jessup. Here boulders from one to three feet in diameter, and well rounded, are heaped together in the greatest confusion, and often without enough sand and gravel to fill the spaces between them.

Soil as Affected by Glaciation.

While the soils of drift-covered regions are frequently very fertile, those of the Wyoming and Lackawanna valleys are, for the most part, poor. The principal exceptions to this are the narrow, broken strips of alluvial lands along the Lackawanna river from just below Carbondale to its mouth, and the broad bottom lands of the Susquehanna. The finer material of the drift generally being spread out over the south-west end of the valley, and the coarser in the north-east end, the country below Wilkes-Barre is, on the whole, better adapted to agriculture than that along the Lackawanna. The reason for the prevailing barrenness of the

soil in this region will be understood when it is remembered, that, as I have already stated, the drift here is almost entirely local, and that these carboniferous rocks have but little or no lime in them.*

I am decidedly of the opinion, however, that the soil of the Lackawanna valley is not so poor as it is generally believed to be. Very little effort has been made to reclaim and improve the land in this end of the valley. This is doubtless due in some part to the fact that the mining companies, which own the land, object to paying damages to owners or renters of the surface when abandoned workings cave in. They therefore prefer to allow the surface to lie idle.

Moreover the great mining and manufacturing interests of this region have tended to draw the population away from less remunerative agriculture. The greater part of the uplands now under cultivation—that in the vicinity and to the south-west of Wilkes-Barre—was cleared and tilled before the importance of anthracite coal was known. There is no essential difference between the upland soil above Scranton and that below Wilkes Barre, and yet, comparatively, there is very little under cultivation in the valley north-east of Scranton.

Local Changes—Black Creek.

Closely connected with the subject of glaciation are certain local phenomena and changes that have taken place, either during or immediately following the glacial epoch, that should be spoken of in this connection. The interesting changes in the bed of the Susquehanna river between Pittston and Kingston are described by Mr. Ashburner. Doubtless similar ones have taken place elsewhere, both in the Susquehanna and in other streams in this region. I would put on record here the evidences that have come under my observation of certain changes in the lower part of Black creek. From the head of the West End breaker the conglomerate ledge to the east and south-east forms a steep precipice, cut through at one point, about 1500′ from the breaker by Black creek, and making here a fall some twenty-five feet in height. Below the falls the walls of conglomerate spread apart, forming a V-shaped gorge with the fall at its apex. This gorge is filled with large, angular fragments of conglomerate, the fallen remains of the original conglomerate ledge. The water of Black creek, after falling over the ledge, ordinarily runs, partly underneath and partly over these fragments, for about one hundred and fifty feet, when it enters a pot-hole in the red shale. This pot-hole is about fifteen feet in diameter. Further down, two hundred feet below the fall, is another pot-hole from fifteen to twenty feet in diameter, likewise in the red shale. As these holes are both full of débris, it was not possible to ascertain their depth. Judging from the position and size of the pot-holes, and from the appearance of the material with which they are filled, they could not have been made by the

* To this same fact Scranton owes the excellence of the water supplied to the city. The streams from which this clear, soft water is brought, rise in and flow for their whole length over the Catskill and Pocono formations, both of which and especially the latter, are poor in lime.

current of the stream that now runs through them. The force of the stream, even when it is swollen to unusual dimensions, is quite broken by the time it reaches these holes, by the large and small fragments through and over which it flows. It cannot stir the stones in these holes, and consequently it is incapable at present of wearing them. A little further to the west a reservoir dam has been built across the stream, and, for some distance along the pipe line leading from it, the bed rock has been uncovered, in places more than one hundred feet above the stream, as it flows below the reservoir. This uncovered surface has the soft, half-decayed and smoothly rounded appearance characteristic of the rocks in the beds of streams, or where they have been worn by water set with stones. There is no confusing this peculiar smoothing of the surface with that done by ice—a subject referred to below.

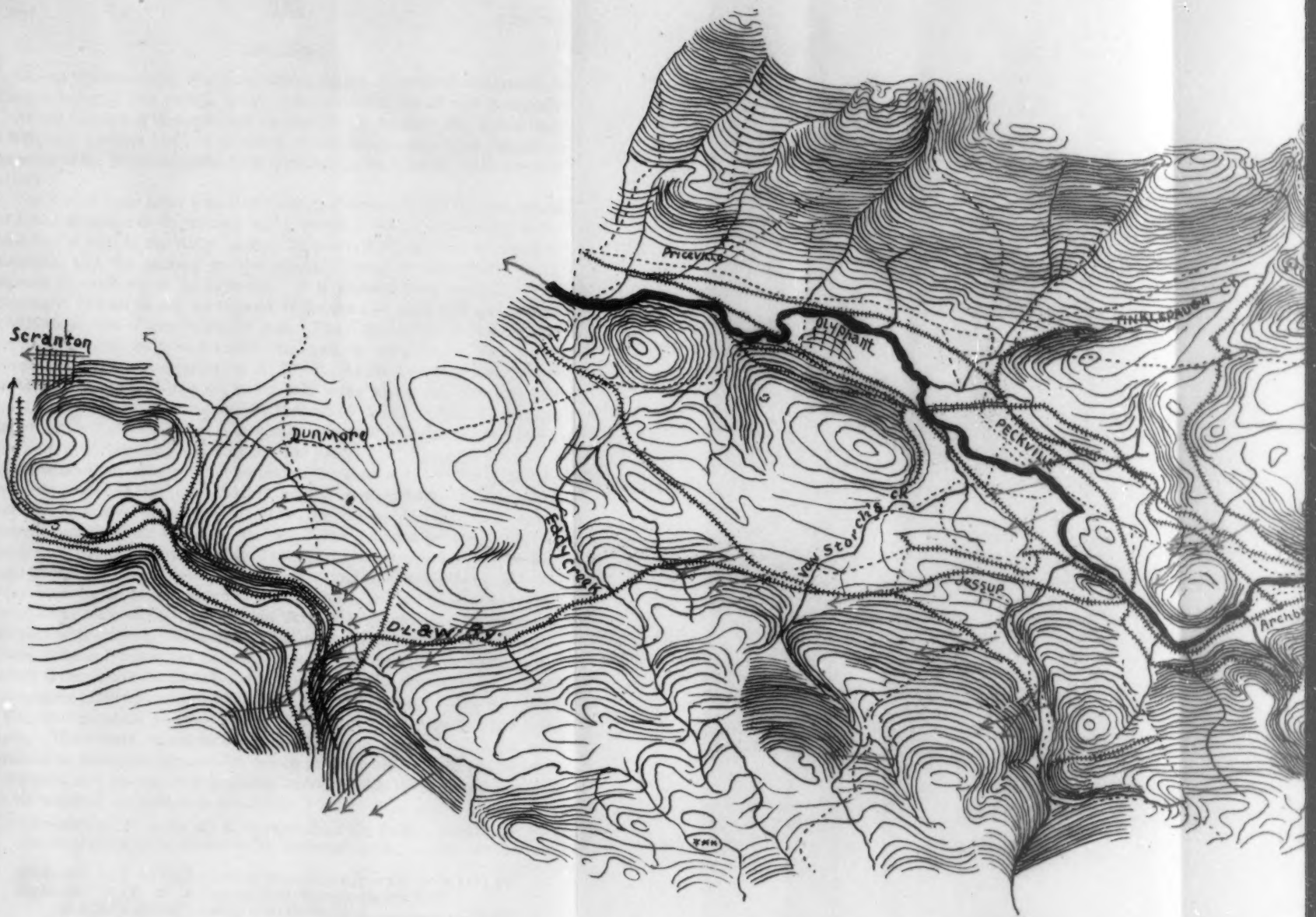
The form of the ravine through which this stream now runs, the character of the débris which fills it, the pot-holes so far below the present position of the fall, and the water-worn surface of the rocks even below these pools are evidences that the falls were once farther to the south-west than at present. But as the conglomerate here dips to the north and north-west, the ledge over which it falls must have been proportionately higher than at present.

Such an elevation of this conglomerate rim—say ten to fifteen feet—would back the water of Black creek until it would leave its present channel near where the road crosses the narrow-gauge railway track, a quarter of a mile above the head of the West End breaker, and send it to the right down the gap through, or near, which the railway is built.*

Further evidence that the water once followed the course mentioned is found in the fact that, in mining beneath this old channel, either a pot-hole or the bed of an ancient stream, filled with sand and water-worn drift material, was cut into by the miners of the West End colliery. The material in this hole was struck some twenty (?) feet below the present surface, but as the workings were abandoned in its immediate vicinity, on account of the inconvenience caused by it, no further developments were made that throw light upon the origin or character of this hole or channel. The removal of some of the drift from the bottom of the mass caused a falling in of the surface. This surface depression made by the hole may be seen north of the track near, and just west of the crossing of the railway track and the dirt road.

But this gorge, if it did exist, was a very narrow one. and easily choked up, and when the floods of the ice age poured over the water-shed at Uplinger's and near the Mountain Inn, the stream down Black Creek valley was probably too large to flow readily through this narrow channel, and so it swept over the low conglomerate barrier which stood more directly in its pathway, and soon wore for itself a broader channel, smoothed the rocks below the falls, and ground out the pot-holes.

*The railway does not run exactly through the original gap. This has been quite filled up by drift and débris from the overhanging cliffs, and the railway passes through a cut a little to the south of the old channel.


Scranton
Dunmore
Fall Creek
D.L.&W.R.R.
Van Storch's Cr.
Jessup
Peckville
Olyphant
Tinklepaugh Cr.
Archbald

LACK

Scr

F

The arrows

SKETCH MAP
OF THE
LACKAWANNA VALLEY
FROM
Scranton to Forest City
PENNSYLVANIA.

Scale:
1 mile = 1 inch.
1885.

⊙ ⊙ *Position of Pot-holes.*
The arrows show the direction of the striae.
← J.C. Branner.

Pot-holes.

Among the interesting local phenomena related, in one way or another, to the glaciation of this valley, are the great pot-holes found near Archbald.

As the first one of these pot-holes is described in detail by Mr. Ashburner, I will only mention here, in speaking of the second one, what appear to be some of the important facts that relate to, or bear upon, their common origin.

The first of these holes was discovered in February, 1884, by the miners of Jones, Simpson & Co. cutting into it where it had penetrated the Archbald bed of coal in the Ridge mines. It was full of sand and water-worn material, and the surface of the ground, being covered with forest, showed no evidence of its presence. It is situated near the foot of the mountain, two miles due north-west of the town of Archbald, and nearly a mile south-east of the Callender gap. The little hollow in which both the holes are situated is half a mile long, and, in this distance, rises about ninety-five feet in the direction of N. 32° E. At the lower end this hollow broadens out, the hill-tops on either side being about five hundred feet apart, and about seventy feet above the top of the first hole, which is at the lower end of the hollow. A small, wet-weather stream runs down this hollow during the greater part of the year.

The second pot-hole is in the bottom of the same hollow 1100′ N. 33° E. from the first. At this point the hill on the north-west is only about ten feet above the level of the stream, while the one to the east rises almost perpendicularly about sixty feet above it. The location of the second or upper hole was discovered in May, 1885, in the same manner, and by the same parties that discovered the first one. Sand and water-worn drift, in every way similar to that found in the first hole, fell into the breast when the opening was made. To prevent further inconvenience in working this part of the mine, the material was propped up, and confined with pillars, to keep it out of the breasts. Not having been cleared of its contents it is impossible to describe this hole in detail, but with the aid of information kindly furnished me by Mr. Edward Jones of Jones, Simpson & Co., the operators of these mines, I am able to give its position and depth. The former, was determined by the mine map. The depth was obtained by using the mine levels, which give the elevation of the bottom of the hole, and my own topographical survey of this vicinity, which gives the elevation of the surface at this point.

Elevation A. T. of the rail at the mouth of the drift	1077.95′
Rise to the bottom of the second or upper pot-hole	49.50′
Elevation A. T. of the bottom of second or upper pot hole	1127.45′
Elevation A. T. of Topographical Survey station 3372, which is almost exactly over the hole	1192.07′
Total depth, including surface	64.62′
Surface—say	14.62′
Approximated depth of pot-hole	50.00′

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From the first, or lower hole the débris was all removed by the mining company, and before it was employed as an air-shaft, it could easily be examined both from above and below. The general profile of this hole along its greatest diameter is rudely that of an inverted riding-boot, the toe pointing about N. 80° E. It is thirty-four feet deep, and, at the top, about twenty feet wide in its smallest diameter, while its longest diameter —the length of the foot of the boot—is not known, the drift filling this prolongation never having been removed. It is not cut straight down, but leans considerably in the direction of the greatest diameter, that is, N. 80° E. In a foot-note on page 111 of Report Z, Professor Lesley refers to this first pot-hole (the second one not having been discovered at that time), and expresses the opinion that it is a glacial pot-hole, caused by the water falling over a crevasse in the glacier. After having gone over the ground repeatedly, and after having made a thorough study of the topography of this region, and of what appear to be all the questions that throw any light upon the subject, the more firmly am I convinced that his is the true and only possible explanation of it.

The theory advanced by Mr. Ashburner, was to the effect that this first hole was made by water flowing down the hollow in which it is situated, at a time when the stream was larger than it is at present, or by a stream coming from the direction of the Callender gap.

In regard to the latter suggestion, it may be replied, that, whatever the possibilities or probabilities may be of a stream having, at any time, flowed into the valley through the Callender gap, the position, inclination, and the direction of the greatest diameter of the top of the pot-hole preclude the possibility of its having been formed by a stream from such a quarter. The inclination and prolongation of the top of the hole point about N. 80° E., while the Callender gap lies N. 55° W. from this place.

That a pot-hole of such dimensions could not possibly have been made by the stream that now runs down through the hollow in which the hole occurs, is too plain to require demonstration; and indeed no such claim, as far as I am aware, has been made. That this stream was once much larger than at present is doubtless true, but, with the present topography, the greatest possible area drained into the hole is less than a quarter of a square mile, or, to speak more exactly, twenty-three hundredths (.23) of a square mile. The torrential rains of the tropics would not be sufficient to produce, upon this surface, a stream big enough to grind out such a pot-hole. If we suppose that the two streams that cross the Callender gap road north of the hole, and the upper part of Tinklepaugh creek may have, at one time, drained into this hole (and, while the first two may have done so, there is scarcely a possibility that this last ever did), the greatest possible area so draining would have been less than two square miles, or, more precisely, 1.85 square miles.*

*These calculations are based upon the topographical map of this region made by the writer, and are known to be trustworthy.

It is scarcely credible that such pot-holes could have been formed by a stream smaller than the Lackawanna at Archbald, and this falling from a considerable height. I say "falling from a height" because, while I know that pot-holes may be, and are, formed in eddies by currents capable of whirling the wearing material inside of them, I do not imagine that any one will claim that even the Lackawanna could whirl the stones in the bottom of even the smaller of these pot-holes, at a depth of thirty-four feet without striking the water in it from a considerable elevation. But even admitting that such a stream might have done this, we should still need to account for such a stream at this place and elevation.

At the Archbald iron bridge the Lackawanna contains the water drained from a hydrographic basin having an area of one hundred and four (104) square miles, and, when at an average height, this stream has, at this point, a volume of 83.441 cubic feet per second. To produce such a stream as this upon an area of less than two square miles, to say nothing of a quarter of a square mile, would require a precipitation surpassing anything of which we have any knowledge. Finally while the difference of elevation between the upper and lower pot-holes is about sixty-five feet in a distance of 1100 feet, the head of this hollow is much flatter, there being but thirty-five feet fall between the head of the hollow and the upper hole—a distance of about 1800′—which is clearly not enough to produce a current sufficiently powerful to move the stones in the bottom of a pot-hole fifty feet deep.

In support of the explanation offered by Professor Lesley, I would call attention to an important, and somewhat remarkable topographical feature in this part of the valley—a feature even more striking when looked at upon the ground, than when seen upon the map. This is a hill that projects, from the vicinity of the pot-hole, directly across the whole valley, in the direction of Archbald, and is only interrupted at this place by a narrow gorge, through which the Lackawanna flows.

Where the "back road," leading from Olyphant to Jermyn, crosses this hill, it is 310′ above the level of the river at Archbald, while 1500′ north-east of the lower pot-hole, it (the hill-top), is 380′ above the river, and 125′ above the mouth of the lower hole, which is *just below the crest of the hill.*

The ice moving down the Lackawanna valley, and over the top of this hill, must have been broken by it into crevasses into which the streams that formed these pot-holes must have plunged. As the ice moved forward, the crevasse would occur at, or about, the same point every time, and so keep the water fall stationary, or nearly so. The shallow prolongation of the upper part of the lower hole was probably caused by the occasional withdrawing of the stream, as it cut the ice more rapidly than it was pushed forward.

The surfaces of the rocks on the top of the hill above the upper pot-hole have been worn smooth by the ice, but being friable sandstones they have failed to preserve any striæ, and although most careful search was made,

no striated exposed surfaces were found anywhere in the immediate vicinity of these holes.

Exactly why the stream flowing over the ice should come from N. 80° E., and not from some other precise point of the compass to the north-east, we have no means of knowing. We do know, however, that very insignificant influences may determine the direction of a stream beginning to form upon the surface of melting ice.

Exactly why there should have been a crevasse above the lower pot-hole is another problem we have no means of solving. The hill to the east of the hole runs to a point just here, and is only sixty feet high. The crest of this ridge is more than a thousand feet to the north-east, and it is here *under its very brow* that one would naturally expect to find a pot-hole, if anywhere in the vicinity. And it is interesting to know that, as a matter of fact, *the second and deeper pot-hole is exactly at this point.*

In considering this question of the origin of these pot-holes I have taken into account the possibility of the water having been thrown over the ridge at the place in question by an ice-dam in the Archbald gorge toward the close of the glacial epoch. While I admit the possibility of such a dam, I do not find that it simplifies the explanation in any way; but, on the contrary, that it would necessitate a great many subordinate hypotheses.

It seems probable also that the circumstances must have been more favorable for the formation of these holes after the ice sheet had begun to retreat, and after it had come somewhat, but not wholly, under the influence of local topography.

As far as I have been able to learn, these two are the only pot-holes of this character that have been discovered in this valley. The one referred to by Prof. Lesley (Report Z, p. 111), as having been mentioned in the *Scranton Republican*, is a small and simple one, made by Laurel run in the soft shales of its bed. Such pot-holes are not uncommon in this region. Besides those referred to on Black creek the writer has seen several along Laurel run near Archbald and in White Oak run between the reservoir and where this stream runs into the Lackawanna. Mr. George M. Lehman found several in Mill creek lower down the valley. Two of these, he says, "are side by side, exactly alike, about the size of a stove-pipe, and just as round."

Water-wearing.

Further evidence that these pot-holes were made by water falling from a considerable height, may be seen in the water-worn condition of the preserved rock surfaces in the vicinity of the lower hole. All the preserved surfaces of these rocks have the rounded and worn appearance that is imparted by falling water. There can be no confusing these with glaciated surfaces. The latter, whether preserving their striæ or not, generally have a regularly rounded appearance, the tendency of the ice being to reduce all irregularities. This smoothing, as has already been said, is most marked upon upward, level, or gently downward gradients. Water,

on the other hand, does its principal wearing on down grades, and especially in cataracts, or, where falling over precipices or obstructions, it can dash the stones, or other grinding material with which it may be charged against the rocky bed below. In such places the erosion caused by ice would be very insignificant or nil. Every one is acquainted with the fantastic forms and miniature pot-holes made in the rocky bed of a stream where it pitches down a cataract. Such cases are common in the carboniferous shales along White Oak run and Laurel run near Archbald, and in the Chemung and Portage rocks of Central New York. In addition to these more specific differences, there is an indefinable one in the softer outlines and appearances of a water-worn surface which generally aids the experienced eye.

Immediately to the north of the lower pot-hole a ledge, that is now breaking up, has this water-worn appearance. Some of the best evidences of the action of water may be seen about 500′ N. 40° W. from the mouth of this hole, and at the foot of the little hill that rises to its north. Here the evidences of wearing by a large stream are unquestionable, although there is now no considerable stream nearer than the Lackawanna at Jermyn, more than a mile and a half away, and 210′ below this level.

On Two New Species of Three-toed Horses from the Upper Miocene, with Notes on the Fauna of the Ticholeptus Beds. By E. D. Cope.

(*Read before the American Philosophical Society, February 19, 1886.*)

ANCHITHERIUM ULTIMUM, sp. nov.

Unusual interest attaches to this horse since it is the latest representative in time of the genus to which it belongs. It is from a horizon above the John Day Miocene, which contains several Loup Fork genera and species, as Protolabis, Hippotherium and Dicotyles. As, however, the *Blastomeryx borealis* Cope occurs at the same locality and horizon, the bed is probably to be referred to the Ticholeptus epoch, which I have shown to be between the John Day and Loup Fork epochs in age, with greater affinities to the latter.* The principal locality is the valley of the Deep river, Montana, but the present species is derived, with those above mentioned, from Cottonwood creek, Oregon.

The *Anchitherium ultimum* is represented in my collection by a nearly complete superior dentition, with palate and sides of skull to the middle of the orbits, and top of skull to above the infraorbital foramen. The size is less than that of the *A. præstans* Cope and *A. equiceps* Cope (? *A. anceps* Marsh) of the John Day bed, and the dental series has the same length as that of the *A. longiciste* Cope, also of the John Day. The animal is adult, and anterior teeth are considerably worn. The posterior molars

* See American Naturalist for April, 1886.

do not display any material differences from those of the *A. longicriste*. The premolars and molars have a well-marked external cingulum, and there is an internal cingulum round the base of the second premolar. The only other cingula are weak ones round the bases of the anterior lobes of the second and third true molars. The anterior intermediate tubercle forms an angulation in the outline of the anterior cross-crest of the premolars, and a rounded enlargement in that of the true molars. The posterior intermediate tubercle has a triangular section. The anterior teeth are curiously unsymmetrical. There are six incisors, the third having a more posterior position on one side than on the other, and having a cupped crown. The crowns of the others are lost. On the right side, behind a diastema rather longer than the transverse width of the crown of the third incisor, is a robust canine tooth. On the opposite side there is no canine tooth, nor a trace of one ever having been there. The diastema separating the canine from the first premolar is long. The latter has but one root and has a rather small crown.

It is in the cranial characters that this species displays the greatest differences from the John Day species. In the first place there is a profound and large preorbital fossa, separated from the orbit by a vertical bow. The preorbital fossa in the John Day species is shallow, and not abruptly defined. In the next place the anterior border of the orbit is above the anterior border of the last molar tooth. In this it agrees only with the large *A. præstans;* in the *A. equiceps* and *A. longicriste*, the anterior border of the orbit is above the anterior part of the second superior molar. Thirdly, the infraorbital foramen is above the middle of the fourth premolar; it is over the posterior part of the third in the three John Day species. Finally, the nareal notch marks the anterior two-fifths of the diastema; it extends much further back in the John Day species, marking either the front or middle of the first premolar. The palate extends about as far anteriorly as in *A. præstans*, viz., to opposite the posterior border of the first true premolar.

Measurements.	M.
Length of diastema from I. 3	.047
" " " " C	.035
" " superior molar series	.079
" " " true molars	.034
" " crown of p. m. 1 (greatest)	.007
Diameters of crown of p. m. ii { anteroposterior	.0145
{ transverse	.0145
" " " " m. i { anteroposterior	.011
{ transverse	.015
" " " " m. iii { anteroposterior	.011
{ transverse	.014
Long diameter of crown of I, 3	.007
Depth of muzzle at middle of diastema	.039

For comparison with this specimen I have used five crania of *A. equiceps*, and one of *A. præstans* and *A. longiciste* each, besides numerous fragmentary jaws.

It was found by Mr. J. L. Wortman in the Ticholeptus beds of Cottonwood creek, Oregon.

I give here a list of the species obtained with this one at the locality in question:

Protohippus, ? sp.
Hippotherium seversum Cope.
" *sinclairi* Wortman.
" *occidentale* Leidy.
Anchitherium ultimum, Cope.
Dicotyles condoni Marsh.
Protolabis transmontanus Cope.
Merycochœrus obliquidens Cope.
Blastomeryx borealis Cope.

The species of the Ticholeptus beds of Montana are the following:

Mastodon proavus Cope.
Protohippus sejunctus Cope.
Merycochœrus montanus Cope.
Merychyus zygomaticus Cope.
" *pariogonus* Cope.
Cyclopidius simus Cope.
Cyclopidius emydinus Cope.
*Pithecistes brevifacies** Cope.
" *decedens* Cope.
" *heterodon* Cope.
Procamelus vel Protolabis, sp.
Blastomeryx borealis Cope.

This horizon is interesting as that in which the genus Mastodon makes its first appearance in America. It is now shown to be the last which contains the genus Anchitherium. See Final Report United States Geological Survey Territories, Vol. iii, p. 18, where some of the characters of this fauna are pointed out. In the list of the Deep River fauna above given occurs the name

MERYCOCHŒRUS OBLIQUIDENS Cope.

This is a species hitherto undescribed, which approaches those of Merychyus in some respects. As it is established on a mandibular ramus only, although this is nearly entire, it cannot be positively decided to which genus it should be referred, as the generic character is only seen in the presence or absence of lachrymal vacuities. However, in all the species of Merychyus, where the parts are preserved, *M. elegans*, *M. arenarum*, and *M. zygomaticus*, the first inferior premolar is one-rooted, while in the species of Merycochœrus it has two roots. In the present animal there are two roots. The symphyseal region is very much contracted, so that if there were three inferior incisors they were small.

This species is smaller than any known species of Merycochœrus, about

*The absence of caries in the teeth of extinct Mammalia is well known. The type specimen of the *Pithecistes brevifacies*, however, displays a carious excavation on the external side of one of its inferior molars. This feature adds to those which indicate the degeneracy and approaching extinction of this type, as I have remarked in my synopsis of the Oreodontidæ, Proceedings American Philosophical Society, 1884, 557.

equaling the larger individuals of *Oreodon culbertsoni*. The molar teeth are, however, relatively larger than in that animal and in the species of Eucrotaphus, and the anterior premolars and incisors smaller and more crowded. The last two premolars are in line, but the second premolar is set obliquely in the jaw so as to overlap the first premolar by the whole of its anterior root, and the third premolar by half of its posterior root. The anterior root is interior, the posterior exterior. The first premolar has a robust root with round section. The crown is but little expanded at the posterior base; anterior part and apex lost. The alveolus of the canine diverges somewhat outward. The symphyseal suture is short and rather deep. Its posterior edge is below the posterior quarter of the third premolar.

The outline of the jaw is nearly vertical behind, with rounded angle, and abrupt excavation below the condyle. Its edge is beveled outwards except opposite the grinding edge of the last molar where there is a thickening on the external side. The masseteric fossa is well impressed, but rather small, descending only to the line mentioned. On the contrary the fossa of the internal pterygoid muscle occupies the entire jaw behind the line of the third molar, and is bounded posteriorly and at the angle, by an incurved edge. Dental foramen opposite middle of last molar. Mental foramen below posterior edge of second premolar.

Measurements.	M.
Length of ramus at line of mental foramen	.150
" " molar series	.096
" " premolar series	.042
" " third premolar	.0125
" " fourth "	.013
Diameters m. ii { anteroposterior	.0165
Diameters m. ii { transverse	.012
Length of m. iii	.025
Depth ramus at p-m. iii	.030
" " " m. iii, front	.035

In the *Merychyus pariogonus* Cope of the Deep River Ticholeptus bed, the posterior part of the ramus is more expanded, and is perfectly rounded, while the other dimensions are considerably smaller.

From Cottonwood creek, Oregon; J. L. Wortman.

HIPPOTHERIUM RECTIDENS, sp. nov.

The probable Loup Fork Upper Miocene formation of Tehuichila, State of Vera Cruz, Mexico, has yielded a third species of three-toed horse, which differs from any of those known to me * I owe the superior molar tooth on which the evidence depends, to my friend, Dr. Santiago Bernad, to whom I am already indebted for the other species known to me, and

*See Proceedings American Philosoph. Society, 1885, p. 150 (1886), for descriptions of two species, *Hippotherium peninsulatum* and *Protohippus castilli*.

described in the Proceedings of the American Philosophical Society, 1885, p. 150. The present animal presents very nearly the same enamel folds as the *H. peninsulatum* Cope, of the same locality, including the subquadrate central loop which is nearly cut off from the anterior lake. But the tooth differs in two essential points, and in some minor ones from that species. It is considerably larger, presenting .6 more area of the grinding surface. The shaft of the tooth, instead of being strongly curved, is straight. Less reliable characters are, first, that the crown is nearly square, while it is oblong in the *H. peninsulatum;* and second, that there are two large loops extending inwards towards the column instead of one. This character may or may not depend on the position of the tooth. Diameters of crown, transverse, 21.5 mm.; anteroposterior, 21.5 mm.; longitudinal, 450 mm. I propose that the species be called *Hippotherium rectidens.*

Vocabulary of the Selish Language. By W. J. Hoffman, M.D., Washington, D. C.

(*Read before the American Philosophical Society, March 19, 1886.*)

The Selish, or Flathead tribe of Indians, is one of a group of tribes constituting what may be termed the eastern division of the Selishan linguistic stock. The tribe is at present located in Jocko valley, Northwestern Montana, near the eastern spurs of the Rocky mountains. The surrounding country is extremely fertile, and abounds in game. The tribe numbers less than one hundred and fifty souls, and the primitive customs are fast giving way to the modern innovations of civilization.

In the accompanying vocabulary, which was obtained in 1884, a peculiarity will be observed in the terms of relationship which is of more than ordinary interest, especially terms which indicate a relative as living, or dead, changes being made after the demise of an individual because the name of the dead is not spoken aloud or in the presence of other relatives.

The words are spelled phonetically, with the addition of a letter or two to simplify orthography, and a few characters as explained below:

a, has the sound of *a* in father.
â, " " " " " " law.
q, " " " " ch, in the German *nicht.*
x, " " " " gh, " " Arabic *gh*, or German *nacht.*
˘, ¯, placed over vowels indicate respectively, short and long sounds.
', indicates an interruption in sound.
/, the accent indicates accented letters, or syllables.
ⁿ, the superior ⁿ, as in eⁿ, indicates nasalized sounds of letters to which it may be attached.
Italicized letters are whispered.

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Man,	Skal′tamĭuq.
Woman,	S′um′ĕm′.
Old man,	Paq′pohot skal′tamĭuq.
Old woman,	Paq′pohot s′um′ĕm′.
Old man, another form,	Sli′optshĭ′.
Young man,	Sku′kwimĕlt′ skal′tamĭuq.
Young woman,	Sku′kwimĕlt′ s′um′ĕm′.
Boy,	*Ku′ku*′ sē′.
Girl,	She′shu*ɯĭt*′ŭm.
Infant,	Oqtĕl′.
Widow,	Sluwe′lŭmpt.
Grass widow,	*S*′tseĕm′.
A widow looking for a husband,	Tsĕl′ĭshkuĕ′.
Indian prostitute,	Uĭ′uquně′, lit., one who runs at large.
City prostitute,	Sin′kalĕ′, lit., fresh meat.
Wife, said by husband,	Nâ′qūuq.
Husband, said by wife,	Sqĕ′lūĭ.
Son, said by father,	S′kŭssĕ′.
Father, said by son,	Liĕ′uq.
Mother, " " "	Skōl.
Daughter, said by father,	Stĕmtshiēlt.
Father, said by daughter,	Inměstĕm.
Mother, " " "	Ĭntum′.
Elder brother,	Inkĕtsht.
Younger brother,	Ĭsīm′tsĕ.
Elder sister, said by younger brother,	*Ĭ′s′ms*ŭmsĕm′.
Elder son's wife, said by father,	Sē′pĕn.
Elder daughter's husband, said by father,	Ĭsne′tshĕnuq′.
Wife's father, said by father,	Sâxē′.
Wife'a father, said by father, after wife's death,	Stshĕel′.
Wife's mother,	N′ilse′tsht.
" " after wife's death,	Stshĕel′.
Wife's elder brother, said by husband,	Ĭs′stests.
Wife's elder brother, after death of wife,	Inkuit′*s*ĭua.
Wife's elder sister, said by husband,	Sestĕm.
Wife's elder sister, after death of wife,	Inkuit′itĕm.
Brother's son,	Ĭsmelq′.
" " after brother's death,	Ĭs′luqūĕlt.
Sister's son,	Ĭntunsh′.
" " after sister's death,	Ĭs′luqūĕlt.
Brother's daughter,	Smĕlq.

Brother's daughter, after brother's death,	Ĭs'luqūelt.
Sister's daughter,	Tūntsh.
" " after sister's death,	Ĭs'luqūĕlt.
Eldest child,	S'shiī'ti.
Youngest child,	Stĕē'uti.
Intermediate, *i. e.*, the second of three, or the third of five children,	Kĕē'usi.
Chief,	I'lĭmi'qu.
Friend,	S'lăqt.
Slave,	Sh'mĕn.
Indian,	S'kĕluq.
Whiteman,	Suī'ăpi.
Frenchman,	Se'ămĕ.
Indian policeman,	Squ'nĕum.
People,	Kuīts'kĕ'luq, lit., many, Indian.
Great Spirit,	Xōlĭntso'tă.
Shaman,	Tlekuilsh.
Doctor,	Squ'malĭĕl'.
Moccasins,	Kĕshil'.
Blanket,	Sitsŭm'.
Earth lodge,	Mĕlta'qulq.
Tule lodge,	Sĭste'qulq.
Skin lodge,	Spie'qulq.
Fire,	Sâl*qlts* hi'.
Ashes,	Kŏlmĭn'.
Smoke,	S'mot.
Bow, of wood,	*Sts*kuī'ltsh ; ski'ŭĭlst.
Bow string,	Tsha'tsinsht.
Sinew, on back of bow,	Tīnsh.
Arrow,	Tapŏmĭ^{n}'.
Notch in end of arrow, for string,	S'kuadlamī'.
Arrow feathers, on shaft,	Tshkŏ'.
Quiver,	Sĭnkolxtĕ'.
War-club,	Tshu'lulĕ'.
Quiver strap,	Tshatsĕ'.
War-spear,	S'mo'loměn'.
Fish spear,	Xlomintĕn'.
Shield,	*S'sh*tlĕ'.
Drum,	Pomēn'.
Fish-line,	Tshatsĕ'.
Fish-net,	*Kă* kă mĕ'.
Pipe (general term),	S'she'nsh.
Pipe, of stone,	S'she'nsh nĭmĕ'.
Pipe-stem, of wood,	*T*'pĕ'.

Spoon,	S'xlu'mĕn.
Knife,	Nin'tshĕmĭn'.
Scraper, iron,	*P'*tsha'mĭn.
Head,	*S'ptl*xe'.
Hair,	Kom'k'n.
Face,	*Sk'tlŏ'*.
Forehead,	*St'shtl*tshŭmĕ'stĕ.
Eye,	*S'tshtl*tŭkŭ'.
Eyelash,	*St'sho'*pŭs.
Ear,	*T'*e'nĕ.
Nose,	*S'*pasa'.
Cheek,	*S'*kultshamūs'.
Mouth,	*S'plt'*mu^{n}tsĕn'.
Tongue,	*Stixus*tshĕ'.
Saliva,	*Spt'*auq.
Throat,	*S*kame'lt'n.
Shoulder,	Sintshumsh'xĕlt.
Nipple,	*Sk'*ŭme'ĭl.
Hip,	Sâkamĕ'ĭ.
Belly,	Olin'.
Navel,	Te'muĕq.
Arm,	Stshouaqĕu'.
Elbow,	Stsh'axosaqĕn.
Wrist,	Skul'tshomĕt'*sn*.
Hand,	Tshēlsh.
Thumb,	Stum'*sht*.
First finger,	Tso'komĭ'.
Second finger,	Siu'lsht.
Little finger,	Stauptke'ĭ
Leg,	St'shamak'tshĭn.
Foot,	St'sūtsu'shĕ.
Blood,	*S'n'*qulq.
Heart,	*S'*puŭs'.
Lung,	Snĭsqtĕl'stĕ.
Liver,	Pĕnĭnsh'.
Stomach,	S'stema'usts.
Antelope,	Sta'ăn.
Buffalo,	Kučikua stema'.
Cattle,	Stema'.
Beaver,	Skalĕu'.
Bear, grizzly,	Sămxĕ' ; sŭmxĕ'.
" cinnamon,	Tl'tshikuĕ n'sămxĕ'.
" black,	Kua'ĭ n'sămxĕ'.
Deer, white-tailed, male,	Soxle'.
" " female,	*Ts*ulqu'.
" black-tailed, male,	Puĕ'.

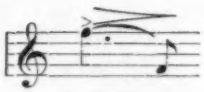
Deer, black-tailed, female,	Stŏltsĕ.
Elk, male,	Tshĕts.
" female,	*S'n*nĕ'.
Fox, generic term,	Xăxă'.
Goat,—mountain,	S'uxlĕ'.
Lynx [*L. rufus*],	Sĭn'xutso.
Moose,	Sxa'sĕlŭks.
Muskrat,	*Tshĭtshĭ*lĕ'uq.
Otter,	*L'*ĭtĕku'.
Panther,	*S'kŭ*tisamĭĕ'.
Rat,—common,	Xĕ'ut.
Rabbit, sage,	*L'*skua'.
" jackass,	Skŭa'ŭktsĭ.
Sheep, mountain [*O. montána*], male,	Xu'l'nĕ'.
Sheep, mountain [*O. montana*], female,	*Xŭ*thŭă''tl.
Wolf [*C. occidentalis*],	*N*tsi'tsă.
Bittern,	Li'lĕ.
Bluebird [*Sialia arctica*],	*N'l'q*kui'kuaĭă.
Blue jay, generic,	Kuăs'kuĭ.
Blackbird [*Agelæus phœniceus*],	*K'ĭtsh*klă'.
Blackbird, yellow-headed [*Xanthocephalus icterocephalus*],	*Skĕk'*itshklă'.
Crossbill [*Loxia curvirostra americana*],	Ai'qusa'.
Crow [sp. ?],	Tsaă'.
Curlew,	Hauĭt'hauĭt'.
Crane,	Skuăltshĭn'.
Coot,	Stĕlak'sha.
Dove [*Z. carolinensis*],	Ua'uia'ŭk.
Duck,	Nŏsŏshinĕ'.
Eagle, bald head,	P'kălqkĕ, lit., white head.
Eagle, bald head, young, with black-tipped tail,	Mĕlkenŏ'.
Grouse [*Bonasa umbella*],	Ka'xit'lsĕ.
Humming bird [*T. colubris*],	Qo'nĭmqo'nĭm.
Hawk,	Tsĕltsĕltshĭmŭ'.
" duck,	Hâ'ıât.
" fish,	Tsi'ŭqtsuq'.
Heron [*Ardea herodias*],	Sâmâkŭĕ'i.
Night heron,	Smatskĕ'uq'.
Kingfisher,	Tsa'dlĭs.
Loon,	Osu'luq.
Lark,	Ŭeuĭt'sulĕ'.
Magpie,	A'*d'n*.

Owl, great-horned,	Sni'neĕ'.
" screech,	*N*'tshitqĕ'.
" American long-eared,	*N*'spuĭsh'*n*'imĕ'.
Prairie hen,	*S*'kâ.
Raven,	Mĕla'.
Swift, white-throated,	Mab'*n*kuĭtsĕn.
Swan,	*S'pk*'ămi'.
Turkey buzzard [this probably refers to the black vulture],	Tsa'kŏwi'ă.
Whip-poor-will (*Phalænoptilus nuttalii*),	Spăs.
Woodpecker,	Stĕlqū'.
"	Sp'ŭăl'xă.
Woodpecker, red-shafted (*Colaptes mexicanus*),	Kul'kuletsh'.
Eel,	Ku'tun.
Oyster,	Sku'skula'nĭ.
Sturgeon,	Tsŭmtū'.
Salmon,	Sŭmqli'.
Trout,	Pīlq.
White fish (*sp.* ?),	Xoĭu'.
Mullet,	Tshilĕ'nē.
Salmon trout,	Xla'ĭ.
Bladder,	Sintshe'ĭtĕ'.
" common term,	Sinl'uaqstĕn.
Scales,	Sĭlktshīm'.
Frog, green (*sp.* ?),	Xĭlm'xlăxa'.
Lizard, newt (*sp.* ?),	Shĭı'shĭltshe.
Rattlesnake,	Xau'lĕuq'.
Toad, black (*sp.* ?),	S'nakŭkuă''m.
Spotted snake,	Tshĕ'uīlĭ.
Gopher snake,	Hŏupo'.
Ant, black,	Sūqŏiĕ'.
Bee,	Ma'tsŭp.
Flea,	*Sk'ŭtŭ*kŭ'ĭ.
Grasshopper,	Tĭta'tsŭp.
Louse,	Kuta'que.
Mosquito,	Si'lăks.
Spider,	Tshĕ'ĭt.
Yellow jacket,	Skol'qt.
Cricket,	Sĭ'luĕnĕ.
Bed bug,	*Ks*'ku'lă.
Tree,	Tsĕl'tsīl.
Stump,	Noqto'sĕ.
Limb,	Tsŏltsīltshĭme'.
Leaf, cottonwood,	Pitstshĕlq.

Leaf, pine leaves,	Tshĕ′me.
Bark, outer,	Tshīlĕ′uq.
" inner,	Tsequ′ĭe.
Trunk,	*S*′tshĕmĕp′.
Root,	Sa′xuĕp.
Clouds,	*S*′*te*tshītēmit′.
Sky,	*Tsh*′*tsh*′ma′skăt.
Sun = Day moon,	S′xalxali′ spŭkani′.
Moon	Spŭkani′.
" = Night moon,	Kwŭkwŭet′ spŭkani′.
Stars,	K′ku′sŭm.
Rainbow,	Skumĭ′utsshĕn.
Fog,	S′hamīp′.
Frost,	Su′lĕuq′.
Snow,	S′mel′kut.
Hail,	Sātlu′sĕ.
Ice,	Shū′emptku.
Water,	Sēul′kqu.
Rain,	Stĭpe′ĭs.
Thunder,	Stel′tĕlăm.
Lightning,	Suŭĕt′shu.
Wind,	Sne′uwŭt.
Dust,	S′ku′ŭlsk.
Mud,	S′slatsha′l′uq.
Sand,	*Skap*xĕ′pe′.
Stone,	S′shĕnsh.
Day,	Sălxalt′.
Night,	Skŭkū′ŭĕ.
Sunrise,	*St*′kleĕtsht′.
Noon,	*N*′*to*′ qken′.
Sunset,	S′tsha′ă.
Yesterday,	Spistsĕ′.
To day,	Tĕt′l′qâ.
To-morrow,	Nĕ′qali′.
Black,	K′ŭai.
Blue,—cobalt,	K′ŭali′*k*′*n*.
Brown,	*Tsh*′*l*′tshĕ′.
Gray, dark,	*Tsh*′xĕ′.
" light,	Tsh′l′pĕ′ik′l′ŭ.
Green, chrome,	Kuĕ′ĭn.
Red, scarlet,	Kuī′l.
Roan [as of a horse],	Xŭa′mukăn.
Sorrel [applied to color of horse],	
" light,	*Pē*′′uq.
" dark,	*Tsh*′l′kŭi′.
White,	Piŭk ; Pīk ; Pĭk.

Yellow,	Kŭă′lĭ.
Horse,	Sĕn′tshilxtsa′ska ; from s'nne—*female elk*, and xtsa′ska—*to ride*.
Ax,	Shĕ′lmīn ; shĭlmīn′.
Log house,	Slu′kut′xŭ.
Dog,	*N*′kŏkŏ′sămi.
Large,	*Kuĭt*tū′ŭnt.
Small,	Kukuĭnmeĕ′.
Much,	Xuit.
Little,	Xlu′ŭĕt.
No,	T'ă.
Yes,	Unĕ′.
This,	I'ĕ′.
That,	Shi'ĕ′.
When,	Pĭstĕm′.
Where,	Tshĕ'l ; s'tshil.
Who,	Suwaĭt′.
What,	Stĕ′'m ; stĕ′ŭm′.
I,	Kŏi′ĭĕ.
Thou,	'N'ŭi′ ; nūk′ŭĕ.
He,	*Tsn*'iqts′.
We (plural),	T'kĕĕ′.
We (dual),	P'le Xĕ′.
You,	*N*'p'lĕ′.
They,	Isĕtsĭpī′qts.
Mine ; me ; I,	Kŏi′ĭĕ′.
Yours,	A′n'uĭ′.
His,	Tsĕnĭqts.
Theirs,	Tsĕni′ĭqts.
Good,	Xēts.
Bad,	Tel′ĭe.
Few,	Xlu′uĭt.
All,	Esĭĭa′.
To shoot (with gun),	Tăpskĕ′.
" " (with arrow),	Tăpskĕ′tăpănĭn′.
Arrow,	Tăpănĭn′.
Mounted (on horseback),	Tshĕmte′.
To ride,	Tshĭl′kalshĕ′.
On foot,	S'xuĭs′tu′.
To kill,	Pūls′tă ; pūlst′ŭm′.
To eat,	I'xl'n.
To drink,	Sūst.
To sleep,	I′tshĭ.
I go to sleep,	Tshĕkeksi′tshĭ.
To smoke,	K'smē′luqui.
To weep,	S'kuă′kuil.

To laugh,	O'ĭĕmtsu'.
I run,	Tsin'kĕxĕtsĕlsht.
You run,	K'uke'tsĕlsht.
He runs,	Ke'tsĕlsht.
You and I run (dual),	Xĕkĕ'tselsht.
We run,	Kēĕ'tsĕlsht.
They run,	Xūkĕtselsht.

When the runners referred to are visible and at a distance from the speaker, the first syllable of the word is uttered in a high note (prolonged to intensify distance), and the last is expressed in a more subdued and lower key. The word, under such circumstances, is Kēĕ'tselsht.

Did you run?	Xa'kukĕ'tsĕlsht.
Knife,	Nin'tshĕmĕn.
" to cut with,	Ni'tshĕnt.
Young dog,	Sti'tĭtshĭ.
I have a dog,	Tshĭnĕp''*xl*'*n*'kŏkŏ'sămi.
How many dogs have you?	Kŭĭnsh'n'kŏkŏ'sămi.
I am hungry,	Tshĭn'ĕstskamĕ'.
We are hungry (plural)	Kĕsi'axee'stskamĕ'.
We are hungry (dual),	Xĕ'ĕstskamĕ'.
You are hungry,	Kuĕsts'kamĕ'.
They are hungry,	Eseshts'ĭltinĕ'kamĕ'.
I strike myself,	Tshĕn'ĭs pĕntsōt'.
I struck myself,	Klĕn'ĭs pĕntsōt'.
I will strike myself,	Nĕm'ĭs pĕntsōt'.
You strike yourself,	Nĕm'kst pĕntōt'.
You struck yourself,	Klĕk'k'sut'pĕntōt'.
I was struck,	Klĕk'kŭ'pĕntsĕm.
You and I were struck,	Kĕ'spĕlxlūlt.
What is it?	Stēm.
Who is it?	Sūĕt'.
What do you want?	Stĕm'aspūs'.

NUMERALS.

1,	N'xō ; N'gō'.	8,	Xēĕd'nŭm.
2,	Sisĕ'.	9,	Xanōt'.
3,	Tshĕxlĕs'.	10,	Opĕn'.
4,	Mōs.	11,	Opĕne'xs n'gō'.
5,	Tsil ; Tsīl.	12,	Opĕne'xs s'sĕ'.
6,	T'a'k'n.	20,	*S*'sĕl o'pĕn.
7,	*Sīs*pxĕtl.	21,	*S*'sĕlo'pĕnexs n'gō'.

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22,	*S'*ɛ̌lo'pěnexs s'ɛ̌l'.	80,	Xenĕ'*l'no*'pěn.
30,	Tshĕ'xl'n'o'pěn.	90,	Xex'*tlo*'pěn.
40,	*M's'ln'* o'pěn.	100,	N'kakē^{a}.
50,	Tsil*xl'no*'pěn.	101,	N'kē^{a}exsn'gō .
60,	*T'k'n*tshilo'pěn.	200,	*S'l'n* qo'qĭ.
70,	S'pĕltsh'lo'pěn.	1000,	O'pěns'tshit'nkĕ'.

Game played with pieces of bone, Mi'tshumtshĕ'.

A game, similar to the chunkey game, played with a ring and poles, is called, S'xâl'ku'.

The Coyote's youngest child (myth), Satsi'uĭnsht'.

There is no word for strike, in the abstract, but the idea is expressed in connection with the manner in which the action is done. This is also the case with some other verbs.

To strike with the hand,	Tsu'ĕntēm'.
" " " a club,	Spŭntĕm'telŭk'.
" " " a gun,	Spŭntĕmtsu'lŭlminsh'.
" " " a bow,	Spŭntĕm*ĩ*tskinsht'.
" " " an ax,	Shilĭntĕm' shilmĭn'.
" " " a knife,	Shilĭnt*ẹ*m'tinin'tshuměn'.
To stab with a knife,	Xlŭntēm'tinin'tshuměn'.
" " " a bayonet,	Xlŭntēm'tsmu'luměn'.
" " " a sword,	Xlŭntēm'tshu'lulĕ'.

Where you going? =

S'tshil	nūk'ŭĕ	s'qŭi?
Where	*you*	*go?*

I am going to the Crows. =

S'tetshem'tshĭ	ō'tshiĕs	s'qŭi'.
Crows [*Indians*]	*I*	*go.*

Don't you wish to trade with me? =
Ō'tsĕmkes tomis'to min'onĕ'?

Give me some sugar. =
Koqui'tsĭsht t'tish.

The following myth is presented to illustrate the syntactic structure of the language.

Sen'-tshĕ-lē'	Ko-tump't.	Sĕ-huist'-tsĕn'tshĕ-lēp,	
[*of the*] *Coyote*	*Story.*	*He was walking, the Coyote,*	[*and*]
ō-wĕ'-tshĕs,	skō-lē'-pĭ*	tō-ō'-sĕ,	huĭ'-huē-iu';
he saw	*they were cooking*	*eggs,*	*many animals and birds;*
s'ă-a-tsu'-qts	wē-titsht'	es-tsĭ-ă'	o-qŏl'-lŭ,
he looked	*while they went to sleep*	*all of them*	*he went,*

* Cooking in a depression in the ground, by paving the floor with stones and covering the food with grass, leaves, etc.

sĕn′-tshĕ′-lē′, t'l′-kĕn-tēs′ t'lŭs-kăl-ēp′. U-il′-qīs
the Coyote, [*and*] *removed the dirt from the cooking place. Then he ate* [*from the eggs*]
tsūs-pĕn-ōs; o-ko-ĕs′ l'hui′-hue-u-ql's * ē-huĕ′-u-ql'sts
everything; [*then*] *he took the little bird* [*and*] *he pulled* [*crosswise*]
x'lus′-pē lēm′-tsĭs; o'k-tsō′-tsĭs xlŭs′-ĕn'k-tsū′; †
the bill; he pressed [*the head*] [*of*] *the lynx;*
sō′-tumst sō′-pŏt xlŏs-qīī-sŭ′-mĭ-ĕ; ‡ o-wĕ′-wĭ′
he pulled (*stretched*) *the tail* [*of*] *the Panther; the Lark*
kwa′-wĭ-lixlts′ xlŏs′-tshi-tshi-ma′ uqts; ō-huīst′-xlu′ sĕn′-tshĕ-le′
yellow breast the breast he made; he walked away the Coyote
tshil-kūt′ xlak′-tshilsht wĕ-x'l-stla′-xlsht. Kă-liqts′
a short distance he sat down [*and*] *he looked at them. They awoke*
xlu-hui′-huē-xults. Sē′-tsĭsh-tshēl′, ha′-xlĕ klĕ′-kĕ-o′-wĭ-tsĕ
all the birds and animals. What is the matter, already we ate all
ū′-kĕ-tĭtsh′? Wē′-kŏl-kwĕ′-tshi-nă′ ta′-sĭn-sō-huī′-nĕ-
before we went to sleep? Talked one they could not under-
mĭn-tēm′. § Kwēmt′-po-mĭn-tsūqt.
stand him. Then they all scattered.

The following is a list of Indian tribes best known to the Selish, and the names which they apply to them:

Pend d'Oreille,	Kalĭspĕl′.
Banak,	Aquĭt′sĕ, "*Gopher-skin-blanket.*"
Shoshoni,	S'nu′uĕ.
Blackfeet,	S'tshu′kuĕ, "*Black-feet.*"
Nez Percès,	Saăp′tĭn.
Arikare,	S'qŭĭes′tshĭ.
Dakota,	Nŭqtu′.
Absaroka = Mountain Crows,	Ste′ămtshĭ.
= River Crows,	S'kuĭ-tshi.
Arapaho,	N'tshĭ'ltshĭ'lu′sŭ, "*Hair-parted-in-the-mid-dle.*"
Cheyenne,	*Sh'k*'kai′usĕ, "*Spotted-arrows.*"
Kutenai,	Skălsē′, "*Water-people.*"
Cœur d'Alene,	Tshi′tsauĭ.

*The Crossbill. It is said the bird lost his speech at this time.

†This act of the Coyote accounts for the flat face of the wild cat—*Lynx rufus.*

‡The Panther received his long tail; was a Lynx previously and had a short one.

§The Crossbill, previously mentioned.

Vocabulary of the Waitshum'ni Dialect, of the Kawi'a Language. Tule Agency, Cal. By W. J. Hoffman, M.D., Washington, D. C.

(Read before the American Philosophical Society, March 19, 1886.)

The material relating to the accompanying vocabulary of the Waitshum'ni, or Waiktshum'ni, dialect of the Kawi'a language of California, was collected chiefly in 1882, but some verifications were made at a subsequent visit to Tule Indian Agency in 1884. The agency headquarters are located eighteen miles east of Porterville, on the south fork of Tule river. The Indians occupy log dwellings, and most of them raise cereals and some fruit. The habitable portion of the agency, or reservation, is nearly two miles in length, and varies from one hundred yards to half a mile in width, either side being flanked by towering ridges of the Sierra Nevada. Game is exceedingly abundant, and game birds, especially the valley quail, are found in almost every copse and grassy lawn.

These Indians manufacture exceedingly fine and durable basket-ware, the coils consisting of three or more strands of long grass, the stitching together being accomplished by using thin strands of split roots of natural, or artificial colors—usually black, red and white. The design which may be denominated a typical one, consists of a sort of serrated character, running straight, or diagonally from the centre to the periphery. The figure of the Yo'kut—*man*, also figures on drinking-vessels, and on women's conical hats. Their food being chiefly obtained from the agent, requires but little exertion on the part of the natives to subsist satisfactorily; but during the autumn great quantities of acorns are gathered, and pounded into meal at such places where this fruit occurs in greatest abundance. Here too, one finds cavities in the boulders which have been made to serve as mortars. The meal is placed in conical baskets, when water is poured over it to extract the bitter principle, after which it is boiled into a mush and eaten cold, the hand serving as a spoon.

But few good crania can be obtained at this day, the one common Indian burial-ground being carefully and unceasingly watched, not so much for fear of losing the bones of their relatives, but on account of their superstitions regarding the dead. In general appearance, these Indians resemble the Pah-Utes of the Nevada side of the mountains. Their personal cleanliness does not give them much care, but there are times when several may be found taking a wash in the river, after having submitted to a very severe sweat-bath in one of the low and partly underground sweat houses.

These are but three or four feet from floor to ceiling, and measure about six feet in diameter. The entrance is low, and about two feet in diameter. A small opening near the ceiling, at the point opposite the entrance, serves as an exit for the smoke from the fire, which is built immediately inside the door, after the bathers have entered and huddled together. During this scorching and sweating process, singing is kept up, and when the proper stage arrives, all of the occupants rush down and into the water.

Many of their primitive rites are still practiced, in secret, though the influence of the agent has had considerable effect in modifying their most trying ceremonies, and in causing them to imitate their white neighbors in observing modern customs relating to church services, burials, etc.

In the following vobabulary the orthography adopted is that referred to in the remarks preliminary to the Selish :

Man,	Ko′tun ; yo′kŭt yo′kutsh.
Men,	Mâ′ni yo′kutsh.
People,	Tra′ătre.
Chief,	Ti′a ; di′a.
Warrior,	Hiau′tra.
Woman,	Mu′kis.
Child,	Wit′ĕp ; wit′ɩĕp.
Father,	Na′tet.
Mother,	Na′shush.
Brother,	Nā′ăt.
Sister,	Hŭ′koish.
" younger,	No′ăt nim
Son,	Pu′tshung.
Daughter,	A′qĭdam ; a′xit.
Wife's brother,	Năpa′tĕm.
Brother's wife,	Idŭwăp.
Wife's father,	Năqa′mĭsh.
" mother,	Untĭp.
Grandfather } paternal and ma- Grandmother } ternal,	E′nĭsh ; e′nas. / Tu′ta ; du′ta ; tu′da.
Brother's son,	Tshai′aq.
" daughter,	Tshai′aq.
Sister's son,	Pu′tshung nim tshai′aq.
" daughter,	Mu′kis nim tshai′aq.
Mother's sister's husband,	Komo′dĭs.
" brother's wife,	Mo′koi.
Father's sister's husband,	Kui′ha.
" brother's wife,	Mo′koi.
Son's son,	Pu′tshung nim pu′tshuⁿ.
" daughter,	Pu′tsung nim a′xit.
Daughter's son,	A′xidĭn nim e′nash.
" daughter,	A′xidĭn nim a′xit.
I, me, my,	Na′.
Thou,	Ma′.
He,	Ta.
She,	Mukes′.
We,	Mai.
You,	Kŭmui′man.
They,	Ka′sin.

We, dual,	Na′ăk.
You, dual,	Ma′ăk.
They, dual,	Tashĭk′.
Shaman,	Ang′tru.
God (Great Spirit),	In′tshĭsh tĭe′dĭtsh.
Demon,	Tawa′tsha.
Alive,	Tād ; dād.
Dead,	Tauwa′tsha ; tauwa′tsa.
Sick,	Tshiga′tsin.
Head,	Tod, dod.
Eye,	Sĕsse′.
Eyes,	Pungoi′ sĕsse′.
Ear,	Tūk.
Hair,	O′tro.
Cheek,	Tran′gĭ.
Chin,	Wupŏi′si.
Nose,	Tring′ĕk.
Mouth,	Sim′ĕ.
Tooth,	Tē′di ; de′di.
Teeth,	Wu′qunĭm te′di.
Tongue,	Tadxad′.
Lip, upper or lower,	Yĭpie′pŭd.
Neck,	Muk′ĕsh.
Adam's apple (Pomum Adami),	Tsadtsad′ĭtsh.
Hand,	Pu′trung.
Thumb,	U′mutru′drung.
Forefinger,	Tru′trukui′.
Second finger,	Tui′nininkui′.
Third finger,	Pin′taluk′.
Little finger,	Pin′taluk′.
Palm,	Tăka′trĭ.
Wrist,	Kĕtrau′shĭd.
Forearm	Putrung′unka′dĭt.
Shoulder,	Pŭids ; pŏits.
Mammæ,	Me′nid ; me′nit.
Back,	Kĕ′wid.
Thigh,	Yo′kotsh.
Leg,	So′ka.
Foot,	Wut′ŭng.
Heel,	Hada′shi ; hata′shi.
Toes, are named the same as the fingers and thumb.	
Sole,	Tăpŭput′wŭtun′gŭn.
Skin,	Tshu′du.
Heart,	Hung′hung.
Liver,	Tīp.

Intestines,	Tos ; dos.
Bladder,	Tshŭion′.
Lung,	Hung hung′intĭshe′.
Water,	Pai′a ; Ĭd′dĭk ; Ĭl′lik.
Hail,	Howa′tron′Ĭd′dĭk.
Snow,	Pŭn′pŭn.
Cloud,	Kŭd′dĕ.
Rain,	Kō′dŏ.
Vapor,	Mâ′drăk.
Tears,	Mŏ′ugant.
Perspiration,	Dō′mak.
Rock,	Ĭa′kau.
Stone,	Putshi′tĕt Ĭa′kau.
Sand,	Wa′gas.
Mountain,	Dŭ′mĭt.
Hill,	Pu′kăt ; bu′kăt.
Valley,	Tshodo′wĭn.
Dust,	Shro′wŏt.
Mud,	Trĕbĕ′gut.
Tree,	Iăp′kin.
Trunk,	Tra′taan.
Branch,	Da′bĕdŭp.
Leaf,	Dăp′dăp.
Stem,	Dăp′dăp in′trătră.
Flower,	E′dau.
Bud,	Dĭ′bing.
White,	Tshŏdōt′.
Red—ochreous,	Pa′tshĭgan.
Yellow—chrome,	Ti′qad.
Green—chrome,	Tri′mad ; Tri′māt.
Blue—French,	Pădi′kăn.
Black,	Tshum′kătaⁿ ; trum′kĕtĕn′.
Vermilion,	Mit′dat pa′tshĭgan.*
Lake,	Trum′kĕtĕn′ mit′dat pa′tshĭgan.†
Here,	Xe′uⁿ.
There,	N′ga′ŭ.
This,	Xe′Ĭ.
That,	Ta.
These,	Xi′săk′.
Those.	Ka.
Now,	Tshăan′.
No,	Ka′mu.
Yes,	Ho.

*Mit′dat—little ; *i. e.*, *little-red.*

†Sig. *Black-little-red.*

When,	Hau′dau.
Where,	Hi′dĕuⁿ.
None,	Ka′muⁿ.
Across,	Po′ŏi′u.
Bear, black,	Deu′qun ; du′qŭn.
" grizzly,	Noⁿ′qoⁿ.
" cinnamon,	Pa′tshigĕdu′qŭn.
Raccoon,	Kuid′tshu ; kuit′shu.
Lynx,	Tung′un.
Panther,	Wuⁿhe′sid.
Coyote,	Kai′ĭu.
Wolf,	Iwait′.
Jack rabbit,	To′pŏl ; do′pŏl.
Badger,	Tăn′nau ; tĭn′nau.
Bird,	Tač′nip.
Crow,	A′dawut′′ĕ.
Vulture,	Tau′ka ; tan′ka.
Jay (Steller's),	Tĭĕshu′dĕtsh.
Quail, valley,	Hu′mut.
Deer,	Hoi.
Elk,	Shōlk′hoi.
Fish,	Lu′pitsh.
Lodge,	Tri′.
Sweat lodge,	Mōs.
Fire,	O′sĕt.
Smoke,	Mo′drek.
Ashes,	Ha′pas ; ha′pash.
Charcoal,	Sa′pan.
Feathers,	Pada′ ; pata′.
Wing feathers,	Ka′păd.
Animal hide,	Tshudui′.
To eat,	Du′i.
To laugh,	Hai′wis.
To drink,	U′kun,
To weep,	A′hin.
To hear,	Dâng.
To know,	Hōt.
To trade,	Sitĕd′ăwăsh.
To think,	Tem′tem ; dem′dem.
To walk,	Hi′wĕt.
To run,	Da′wĭt.
To fall,	Ui′in.
To ride horseback,	Had′hin.
To talk,	Xa′hĭ.
To sleep,	Man′gĭs.
To die,	Tau′ĭts.

To like, or admire,*	Ho′iutshă ; hu′yutsha.
To kill,	Tau′tra ; tau′trat.
To shoot an arrow,	T"′ui ; Tr"′ui.
To strike with a club,	Witshe′trŭm wat′r.
" " " knife,	Nokŏits′ŭn wat′r.
" " " stick,	Wat′r.
To cut with a knife,	Tshīs.
" " " an ax,	A′t′r.
Much,	Wai′ĭdĭ ; wu′qĭ.
Many,	Wu′qoi ; wu′qĭ.
Many bows,	Wu′qoi tai′up.
Two bows,	Pun′goi tai′up.
Bow,	Taiup.
Bow string of sinew,	Tooiq′tut.
" " loop for securing at end of bow,	Pēt ; pĭt ; pēt.
Front side of bow,	Ke′wĕt.
Cord side of bow,	Ko′tro.
Arrow poison,	Hai′ĕnĭt.

The parts of an arrow, having a wooden point detachable from the shaft, are as follows :

Point of wooden arrow-head shaft,	Sha′padan ; tshi′pidun.
Body of wooden arrow-head,	Sho′toitsh.
Shaft of arrow proper,	Sik′kid.
Feathers,	Tshodon′gĭsh.
Notch, at base of shaft,	Tin′nĕiu.
Sinew fibres at head of shaft to prevent splitting upon introduction of arrow-head,	Pik′kĕd.

NUMERALS.

1,	Yēt ; Yet.	13,	Sho′piŭm.
2,	Pun′goi ; bun′gŏi ; pun′ga.	14,	Hatsh′pŭm.
3,	Shrâ′pĭn ; sho′pĭn ; tro′pĭn.	15,	Yit′sum.
4,	Hâtpun′gĭ.	16,	Tshud′pum.
5,	Yit′singĭt ; yet′singĭt.	17,	Num′tshum.
6,	Tshu′dĭpi ; tsho′dĭpi.	18,	Mun′shum.
7,	Nump′tsin.	19,	Nont′pum.
8,	Mu′nŭs.	20,	Pungat′shium′.
9,	No′nĭp.	21,	Pungat′riayet′.
10,	Tri′o ; dri′o ; tri′a.	30,	Shrâ′pĭntri′a.
11,	Ie′tsum.	40.	Hâtpun′gitri′a.
12,	Tshi′uka[n].	50,	Yit′singatri′a.

* Also in the sense of *to love*, although there is no word for love as ordinarily recognized.

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60, Tshu'dĭpitri'a.
70, Num'tshetri'a.
80, Mu'natri'a.
90, No'nĭptri'a.
100, Yet'pitsh.
101, Yet'pitshĭo yet'.
1000, Tri'apitsh'a.
2000, Pun'gatri'apitsh'a.
3000, Shrâpintri'apitsh'a.

Ho'iutsha—*To like, to admire.*

PRESENT TENSE.

Sing. 1. Nim ho'iutsha.
2. Min ho'iutsha.
3. Ta ho'iutsha.

Plural. 1. Wai'tung ho'iutshet.
2. Kumuiman ho'iutshet.
3. Kasin'tun ho'iutshet.

Dual. 1. Na'aktang ho'iutshet. (We two.)
2. Ma'aktang ho'iutshet. (Ye two.)
3. Tashīk'tang ho'iutshet. (They two.)

PAST TENSE.

Sing. 1. Ni'amtang yūd ho'iutshush.
2. Ma'tang yūd ho'iutshush.
3. Ta tang yūd ho'iutshush.

Plural. 1. Wai'tung yūd ho'iutshush.
2. Kumuiman yūd ho'iutshush.
3. Kasin'tun yūd ho'iutshush.

Dual. 1. Na'ak tang yūd ho'iutshush.
2. Ma'ak tang yūd ho'iutshush.
3. Ta shīk'tang yūd ho'iutshush.

FUTURE TENSE.

Sing. 1. Na tang'he ho'iutshe.
2. Ma tang'he ho'iutshe.
3. Ta tang'he ho'iutshe.

Plural. 1. Wai'tung tan ho'iutshe.
2. Kumuiman tan ho'iutshe.
3. Kasin'tun tan ho'iutshe.

Dual. 1. Na′ak tang tan ho′iutshe.
2. Ma′ak tang tan ho′iutshe.
3. Ta shīk′tang tan ho′iutshe.

Tau′trat—*To kill.*

PRESENT TENSE.

Sing. 1. Tshan na tang tau′trat.
2. Tshan ma tang tau′trat.
3. Tshan ta tang tau′trat.

Plural. 1. Wai′tung tshan tang tau′trat.
2. Kumuiman tshan tang tau′trat.
3. Kasin′tun tshan tang tau′trat.

Dual. 1. Na′aktang tshan tau′trat.
2. Ma′aktang tshan tau′trat.
3. Ta shīk′tang tshan tau′trat.

PAST TENSE.

Sing. 1. Hiăm′na tang tau′trash.
2. Hĭam′ma tang tau′trash.
3. Hĭam′ta tang tau′trash.

Plural. 1. Hĭam′waitung tau′trash.
2. Hĭam′kumuiman tau′trash.
3. Hĭam′kasin′tun tau′trash.

Dual. 1. Hĭam′na′aktang tau′trash.
2. Hĭam′na′aktang tau′trash.
3. Hĭam′tashīk′tang tau′trash.

FUTURE TENSE.

Sing. 1. Na tang′he hĭam′xash tau′tret.
2. Ma tang′he hĭam′xash tau′tret.
3. Ta tang′he hĭam′xash tau′tret.

Plural. 1. Waitung tang′he hĭam′xash tau′tret.
2. Kumuiman tang′he hĭam′xash tau′tret.
3. Kasintun tang′he hĭam′xash tau′tret.

Dual. 1. Hĭam′ xash na′aktang tau′tret.
2. Hĭam′xash ma′aktang tau′trat.
3. Hĭam′xash tashīk′tang tau′trat.

Discovery of the Thoracic Feet in a Carboniferous Phyllocaridan. By A. S. Packard.

(*Read before the American Philosophical Society, February 5th, 1886.*)

It is a matter of some surprise that notwithstanding the large number of fossil Phyllocarida from the Palæozoic strata made known to us by the researches of McCoy, Salter, Barrande, H. Woodward, James Hall, J. M. Clark, R. P. Whitfield, C. E. Beecher and others, no definite, unmistakable traces of the limbs have been discovered. So far as we are aware, no portions of the antennæ of either pair, nor of the thoracic or abdominal limbs (except those next to the telson), have been figured or described, though many specimens of the fossils have been subjected to the scrutiny of our leading palæontologists. While most of the species are represented by the bivalvular carapace alone, which must have been, as in the recent Nebalia, easily detached after death from the body so as to float away by itself, still in some cases, as in that of *Ceratiocaris stygia* Salter, figured by Messrs. Jones and Woodward in the *Geological Magazine* for September, 1885, the abdominal segments, with the last pair of uropoda and the telson, are distinctly preserved, while in other cases the large toothed mandibles are preserved in place between the valves of the carapace; the rostrum has also sometimes been preserved. But we should have expected ere this to have become acquainted with the nature of the antennæ and the anterior abdominal appendages, if, as we have good reason to suppose, they were like those of the modern Nebalia.

In their diagnosis of the genus Ceratiocaris, Messrs. Jones and Woodward in referring to the body, state: "Body many-jointed, with fourteen or more segments, of which 4–7 extend beyond the carapace; ornamented with delicate raised lines. Some or all of these segments bore small, lamelliform, branchial appendages."*

Although Messrs. Jones and Woodward have kindly sent me nearly all their valuable papers on fossil Crustacea, those cited in the foot-note, unfortunately are not among the number, and hence I am unable to refer to them. Mr. Etheridge's note in the Annals and Magazine Natural History is as follows:

"At the Brighton meeting of the British Association, Mr. H. Woodward, F.R.S., noticed the discovery of the 'swimming gills' of *Ceratiocaris*, to which I had previously drawn his attention. On a slab of thin flaggy shale from the Upper Silurian series of Lesmahagow are exposed, the caudal segments, telson, and caudal appendages of a *Ceratiocaris*. From the ventral margin of the terminal segment proceeds a broad paddle-shaped membraneous (?) expansion, presenting a strong marginal outline,

* See the Sixth Report on Fossil Crustacea, Brit. Assoc. Report for 1872, p. 323, and Geological Magazine, ix, p. 561. Also a descriptive note by Mr. R. Etheridge, given in the Mem. Geol. Surv. Scotl. Explan. Sheet 23, 1873, p. 93, and Annals and Mag. Nat. Hist. Ser. 4, Vol. xiv, 1874, p. 9.

with a transversely striated surface. This is followed by another similar appendage, proceeding in the same manner from the penultimate segment. The dorsal edge of the specimen shows that one of the corresponding 'foot-gills' of the opposite side has been bent back upon itself, and thus thrust out of place. The free ends of these paddle-shaped appendages are attenuated to more or less rounded points. They do not show any evidence of a marginal fringe. These gill feet are no doubt analogous to the same supplementary abdominal organs in *Nebalia.*"

I do not understand from the foregoing description, the nature of the so-called appendages, especially since they are not figured, but will now proceed to call attention to those noticed in a specimen sent me a year ago by J. C. Carr, Esq., of Morris, Illinois, which occurred in a nodule from the Carboniferous beds of Mazon creek at Morris.

As soon as I examined the fossil, the indications of broad lamellate appendages of several pairs were at once apparent. Owing to the incomplete state of preservation of the dorsal and ventral edges of the valves I was at a loss to what group to refer the fossil. It was apparently a Phyllocaridan, but seemed to differ from most of the genera described. I therefore considered it as the type of a new genus intermediate between Ceratiocaris and Aristozoe, and named it *Cryptozoe;* it may be called *Cryptozoe problematicus.* After, however, comparing the specimen with Dr. Woodward's figure of the Carboniferous *Ceratiocaris oretonensis* Woodw. and *C. truncatus* Woodw. (*Geological Magazine,* viii, March. 1871), and his figure of *C. papilio* Salter and *C. stygia* Salter (*Geological Maguzine,* September, 1883), I was inclined to provisionally regard it as belonging to that genus.

But on consulting my friend, Mr. C. E. Beecher, who has worked so faithfully on the fossil Phyllocarida, he kindly sent me the following opinion:

ALBANY, Dec. 30, 1885.

The typical Ceratiocaris (see McCoy's description) differs from your specimen in its semi-elliptical outline, with the abruptly truncated posterior end and evenly convex valves.

Your species has a short hinge-line, very broadly rounded posterior end, and the cephalic and thoracic regions of the carapace are well defined. These are characters which do not belong to Ceratiocaris when strictly defined. The contour of the dorso-anterior extremity would seem to indicate the presence of a well-developed rostrum. The typical Ceratiocaris are from the Silurian system, and I very much doubt their extension into the Carboniferous, although they have been noted in the Devonian. I have not seen the article by Woodward and Jones which you mention.

I should be inclined to consider this as a type of a new genus.

It is very interesting, especially as furnishing some information as to the appendages.

CHAS. E. BEECHER.

The generic characters as drawn from the carapace alone are as follows: Valves one half as long as broad; moderately full and convex, with no definite, straight hinge-margin. It differs from Ceratiocaris in the lack of a long, straight hinge-margin, the dorsal edge being curved, and in the lower edge not being thickened, while the posterior end is well rounded. The anterior end of the valves is about half as wide as the posterior end, and is oblique, the lower part of the edge being directed outwards. From Aristozoe it differs in the lack of a definite hinge-margin, and in its elongated oval valves; from Nothozoe in its well defined narrow anterior end, and well defined dorsal and ventral edges.

As Mr. Scudder's genus Rhachura* from the Carboniferous limestone of Danville, Illinois, is only represented by the end of the abdomen, it is impossible to discuss its relationship to that form.

The specimen is a cast, and shows no tracings of markings on the exterior of the valves. In form it is ovate, obliquely truncated at each end; the dorsal edge is not so much curved as the ventral edge, but it is more curved towards the posterior edge than towards the anterior; the ventral edge is quite regularly curved. The anterior end is obliquely truncated, the lower angle directed outwards. The posterior edge is about a third wider than the anterior end, and is directed obliquely inwards so as to be nearly parallel with the anterior end. While each end of the valves is well preserved, the dorsal and ventral edges have apparently not been preserved, as they are usually thickened in the other species of the genus.

The lamellate limbs are situated in the specimen at the posterior end of the carapace; probably after death the carapace turned around and separated from the body, which with the extremities became much displaced.

Of the lamellate limbs there are traces of four pairs. They are broad and thin, slightly contracted in width near the base, and at the distal extremity quite regularly rounded, with the free ends apparently slightly folded longitudinally, the edges appearing to be slightly crenulated, but

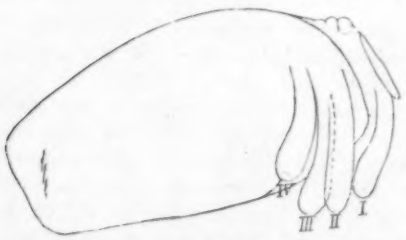


FIG. 3.—Outline of *Cryptozoe problematicus*, showing the shape of the lamellate feet, the valve being upside down.

these folds were perhaps due to changes after death. All the feet are of nearly the same size. They are about two thirds as long as the carapace

* Proc. Bost. Soc. Nat. Hist. xix, 1878, Pl. 8, Fig. 3, 3*a*.

FIG. 1.

FIG. 2.

Cryptozoë problematicus Pack.

is high; the length of the best preserved one 18mm, the breadth 3–4mm. There are no traces of a division into endopodites and exopodites; but we should regard the parts preserved as the homologues of the exopodites of Nebalia; there are no traces of setæ on the edges. The general appearance of the appendage is much as in Pl. xxxvii, Fig. 6, of our monograph of North American Phyllopod Crustacea. Length of the carapace 46mm; height at the highest part, 26; at the anterior end 12–13mm.

From the foregoing description it seems reasonable to suppose that in the fossil forms, Ceratiocaris and allied forms at least, the thoracic feet were, in shape and structure, homologous with those of the modern Nebalia.

Beyond the feet, at the larger or posterior end of the carapace is the impression of what may have been the basal joint of one of the basal abdominal feet, which joint in Nebalia is as long as the lamellate thoracic appendages; but this, of course, is quite problematical.

It is not a little strange that no undoubted traces of the antennæ or basal abdominal limbs of any extinct Phyllocaridan have as yet been brought to light; but the discovery of these large, broad, thin, lobular appendages which most probably belonged to the thorax, makes it all the more likely that the extinct Phyllocarida had antennæ, and basal abdominal limbs similar to those of the existing Nebalia.

Explanation of the Plate.

Fig. 1. Cast of carapace of *Cryptozoe problematicus* Pack., natural size.

Fig. 2. Reverse of the same, showing the impressions of the lamellate feet originally attached to the thorax.

The Use of Oil in Storms at Sea. By Lieut. A. B. Wyckoff, U. S. N.

(*Read before the American Philosophical Society, April 2, 1886.*)

My attention was drawn to this subject in 1884, soon after I took charge of the Branch Hydrographic Office in Philadelphia. Several Masters of vessels described their methods of using it, and the striking results of their practical experiments. I became convinced of its great utility; and in November, 1884, reported the matter in a letter to the Hydrographic Office. Soon afterwards, orders were given the branch offices, to collect all the information they could obtain regarding its use; and in January, 1885, the data, thus collected, was published upon the monthly North Atlantic Pilot Chart. This has been continued ever since, and the Hydrographer, Commander J. R. Bartlett, has done everything in his power to interest mariners in the subject. In consequence, where one vessel formerly used it, there are probably now fifty prepared for such an emergency.

In view of the unvarying successful result, the time must soon come, when no vessel will leave port without some cheap fish or vegetable oil, for this purpose. Insurance companies, owners and masters of vessels, are all too greatly interested, to have this precaution longer neglected.

The use of oil in calming troubled waters, was evidently well known to the ancients, as Aristotle, Plutarch and Pliny refer to it in their writings. The divers in the Mediterranean still use it in the manner described by Pliny—taking oil in their mouths, and ejecting a little at a time, to quiet the surface and permit the rays of light to reach them. Fishermen, who depend upon the spear to capture their prey, pour oil on the water to calm it, and enable them to clearly see the fish. The hardy fishermen of the north of Scotland and along the shores of Norway, have known this use of oil for centuries. When crossing a dangerous bar or tide-rip, or when landing through surf, they press the livers of the fish until the oil exudes, and then throw them in advance of their boats. The Lisbon fishermen carry oil with them, and use it in crossing the bar of the Tagus, in rough weather. Whalers have resorted to oil and blubber, in severe storms, for the last two hundred years. Very recently, an old whaler informed me, that it was their custom to hang large pieces of blubber over each quarter of their vessel, when running before a heavy sea, and it entirely prevented the water coming on board.

The members of this Society should take special interest in this subject, because its founder made many experiments, and left his views on record regarding the great utility of oil for this purpose. On a stormy day, he calmed the surface of a pond covering a half acre, by pouring a single teaspoonful of oil upon its windward side. He afterwards made other laborious tests upon the waves of the sea, and gave a scientific explanation of the manner in which the oil acted. This explanation is still believed to be substantially correct.

Molecules of water move with freedom, and the friction of air in motion upon the surface of a body of water, produces undulations. These increase in size, proportionately to the depth of water, the distance they can proceed to leeward, the strength of the wind and the time it is acting. There is a limit, of course, to this increase in height; none probably ever exceeding forty feet.

The precursor of a cyclone in the North Atlantic, is often, what is known to seamen, as a heavy swell. It may be perfectly calm when this reaches a vessel. It is simply a long, high undulation; started by the storm, and traversing the ocean in advance of it. Off the coast of California, I have experienced the tremendous swells, made by a westerly wind across the immense stretch of the North Pacific. These undulations were as high as any I have ever seen, and yet, on calm days, I have often ridden them in an ordinary whale boat. These swells correspond to oiled waves. The boat or vessel slides up their front slope, and down the rear. Let a sudden gale spring up, like the "Northers" in the Gulf of Mexico, and the harmless swells becomes raging seas. How is this change effected?

The friction of the wind, upon the exposed slope of the swell, produces little irregularities of the surface. These wavelets are driven up the slope to the summit of the undulation. At the same time, the forward slope is more and more protected from the wind, and, because of its inertia, becomes steeper and steeper. Any one who ever saw a sand dune within the limits of the trade winds, has seen the storm wave in permanent form —a long windward slope and abrupt leeward face. The constantly sharpening crest of the storm wave, is finally thrown forward and downward with a force proportionate to its weight and speed. When this storm wave encounters a ship, the vessel cannot rise up the abrupt front. Instead, she checks the progress of the base of the wave, and the crest is thrown forward with tremendous violence, filling her deck and sweeping away men, boats and everything movable. The storm wave is, perhaps, no higher than the heavy swell, and only differs from it in shape. Oil changes the storm wave into the heavy swell. How is this done? The scientific explanations given with great minuteness, that I have seen, would only be confusing to the ordinary mariner. My opinion is: that the oil with its less specific gravity floats on the surface, and spreads rapidly, forming a film, like an extremely thin rubber blanket, over the water. Because of the viscosity of the oil, and its lubricant nature, the friction of the wind is not sufficient to tear this film, and send individual particles rolling up to the summit. At the same time, the molecules of water beneath are protected; and, although the force of the wind may increase the speed of the undulation as a body, it will be as a heavy swell, and no longer in the shape of a storm wave. This effect can always be obtained at sea, if a suitable oil is used. It has been supposed, that the oil exerts some chemical action in dissolving the foam, as is witnessed, when it stops the frothing of pulp in a paper mill. It is more probable, however, as Dr. Franklin says, that the effect is purely mechanical.

I have examined one hundred and fifteen reports of the use of oil in storms at sea, published by the Hydrographic Office, and find all the trials were very successful, except four. In these, refined petroleum was used. In one instance, sperm oil was said to have thickened so that it did not spread freely; but in four others, it acted very well. Fish oil was used 9 times, crude petroleum 3, pine oil 3, linseed 22, lard 5, neat's-foot 1, colza 2, and varnish 3 times. In 58 trials, the kind of oil used is not specified. It is apparent, that the heavier oils are the most efficacious. The result in every instance, where used by a novice, is of extreme astonishment at the wonderful effect. One trial seems convincing, and soon it is hoped, the whole profession of merchant officers will be converts, and always go prepared.

In using oil for this purpose, it is evident that it must be spread well to windward, in order to be efficacious. In consequence, a steamer plunging into a head sea, or a sailing vessel on a wind, can derive no benefit. But any vessel driving before a gale, or lying to and making a dead drift to leeward, gets the full protection of its use. As all vessels, except per-

PROC. AMER. PHILOS. SOC. XXIII. 123. 2W. PRINTED JUNE 10, 1886.

haps the rapid passenger steamers of the Atlantic, assume one of these two positions in a storm, the oil is of very general application. Even the fast passenger steamers, in crossing to the eastward before the winter gales, or when, for any reason, their machinery is stopped, will find it invaluable in saving their boats and upper works. Many vessels have found it of great utility, in passing the dreaded trough of the sea, either in heaving to or getting before the wind.

The ordinary methods adopted for distributing the oil are: to pour it down the pipes forward, or place oil alone, or oil and oakum, in canvas bags with holes punched in them, or in bags made of coarse material, as gunny or corn sacks. These are hung over the ship's side wherever required. In my opinion, the bags should always be placed over the bows; as in running, there is time for the oil to spread, and when lying to, it is needed as far forward as possible. From the reports received, I should judge that one gallon of oil, when properly distributed, should last a vessel at least four hours.

In lowering a boat in a sea-way, oil is of great advantage. If to rescue the crew of a disabled vessel, the rescuer should take a position to windward, and distribute a quantity of oil. After the boats have been started, the rescuing vessel should drop to leeward to pick them up. The boats should carry oil to use in running before the sea.

A bottle of oil, with a quill in the cork, should always be kept attached to every life buoy. When a man falls overboard and reaches the life buoy, the oil will prevent the waves breaking over him, and enable the rescuing boat to find him, by the "slick" on the water. There should be an oil tank in every ship's boat, in the event of it becoming necessary to abandon the vessel. Riding to a drogue, made of the masts or oars, a small expenditure of oil will enable a boat to live through a severe storm.

At the entrance of a harbor, or river with a deep bar, oil can be used to great advantage, as has been proven by the experiments in England. When, however, the waves strike a beach, the problem becomes very different. The base of the wave is then retarded by the shoaling depth and the undertow from its predecessor, and, of necessity, the crest is thrown violently forward. Oil cannot prevent this; but it will certainly have considerable effect upon the outer line of breakers, and enable a boat to approach so much nearer the beach, as to greatly increase the chances of a favorable issue. However, many instances are given of the successful landing of boats, through surf and breakers, that would have overwhelmed them without the use of oil.

I append some illustrations of the practical use of oil, in some of the emergencies to which I have referred.

In 1881, a Mr. Fondacaro arrived at Naples from Montevideo, in a three-ton boat built by himself. When caught in a gale, a bag was thrown over as a drag; and two oil bags were put over, one forward and the other aft. The oil circled around the boat, and prevented the seas breaking over her.

One gallon of oil lasted about twenty-four hours. Mr. Fondacaro says, "the oil does not diminish the size of the waves, but renders them comparatively harmless by preventing them from breaking."

The chief officer of the S. S. *Diamond*, wrecked off the Island of Anholt, describes their escape from the wreck. He provided each boat with a five-gallon can of oil, and stationed a man to pour it gradually over the stern. Immediately the sea, in the wake of the boats, became perfectly smooth, and they passed right through the boiling surf, and reached the land in safety, without shipping a sea. None of the men in the boats believed, when they left the ship, that all would reach the shore alive; and the people on land watched their approach in wonder, deeming it impossible for even the life-boat to live in such awful breakers. (The chief officer evidently means, that the sea ceased to break in the wake of the boats; not that it became perfectly level.)

Capt. E. E. Thomas, of the S. S. *Chillingham*, writes, that during a voyage from Philadelphia to Queenstown in March, 1883, he encountered a heavy gale from S.W. "For forty-eight hours we ran before the gale, and during the whole of the time we shipped very heavy seas, and the decks were continually full of water fore and aft. We then had two oil bags made, filled them, and made one fast to the ring of each anchor over the bows. Within a few moments we saw the effects of it on the seas. In the wake of the ship they did not break, whereas, outside of our wake the waves were breaking in all directions. Up to then, we had run before the gale for forty-eight hours without heaving the log, none of the crew daring to go aft for fear of being washed overboard. After using the oil we did not ship any heavy seas whatever, and ever since we always use oil when running before a heavy sea. I would also recommend it to be used in ships that are lying to in heavy seas. The bags were slung about two feet below the anchors, so that when the vessel pitched they were, at times, just awash. About one quart of colza oil was put in each bag every four hours."

Capt. Jones, of the British S. S. *Chicago*, while rescuing the crew of the brigantine *Fedora*, used oil with the best results. It was blowing a heavy gale with very high seas. The *Chicago* ran to windward of the *Fedora*, and, during a lull, oil having been poured on the water, the port life-boat was successfully launched and started. A can of oil was taken in the boat, and by using this the seas were kept down in the immediate vicinity, though they broke in masses of foam a short distance away. As the boat approached the *Fedora*, the crew of that vessel poured oil on the water, which so calmed the sea that the boat got alongside and rescued the shipwrecked crew without sustaining any injury. About half a gallon of paint oil was used by the boat during her trip.

The S. S. *Menzaleh*, in March, 1885, from Italy to Philadelphia, encountered a severe S. W. gale. While running before the sea, the vessel was pooped and the main hatches were stove in. It was determined to heave to, and men were stationed to drip oil down the forward shutes. The

vessel came around without shipping any water, and kept perfectly dry while lying to.

Captain J. E. Lewis, master of schooner *Lawrence Haines*, reports that he used oil when hove to in a terrible N. N. E. gale off Hatteras, on December 26th and 27th; force of wind from fifty to sixty miles per hour. He put over three bags containing oakum and oil; one forward, one aft, and one amidships, and hanging so as to dip as the vessel rolled. Oil used, mixture of linseed, tar and kerosene oil. The bags were used thirty hours, and three gallons of the mixture were expended. He claims that his vessel was saved by the use of oil.

Captain E. L. Arey, of the schooner *Jennie A. Cheney*, writes: "I used oil with very satisfactory results during the late severe hurricane of the 25th of August, in latitude 31° N., longitude 79° W. The wind having carried away the mainsail, I bent a storm trysail, and continued under that sail until it also blew away. During the time, the vessel was shipping large quantities of water, the sea being very irregular, nearly every one breaking. After the sails were blown away, finding it necessary to do something to save the ship and crew, I took a small canvas bag and turned about five gallons of linseed oil into it, and hung it over the starboard quarter. The wash of the sea caused a little of the oil to leak out, and smoothed the surface, so that for ten hours no water broke aboard. I consider that the oil used, during the last and heaviest part of the hurricane, saved vessel and crew."

An Obituary Notice of the Late George Whitney. By William Sellers.

(*Read before the American Philosophical Society, February 19, 1886.*)

The subject of this memoir was born in Brownville, New York State, October 17th, 1819. He was educated at the Albany Academy, Albany, N. Y., where he distinguished himself by his quickness of perception and aptitude for learning, which enabled him to carry off the honors of his class in successive competitive examinations and to obtain a large share of the prizes given each term.

At an early age George Whitney developed a decided preference for studies in natural philosophy, drawing and mechanics. In 1832 his father, Mr. Asa Whitney, was appointed Superintendent of the Mohawk and Hudson River Railroad, one of the earliest steam roads in this country, and his son George availed himself, on all holiday occasions, of the opportunity thus presented of acquiring familiarity with the mechanism of the engines and the practical operation of the road.

As a draughtsman, George Whitney was equaled by few, and his beautiful drawings of some of the first English locomotives sent to America

(made when he was quite a youth), are still preserved in his family, and are tangible evidences of his skill in this direction.

Mr. Whitney's taste naturally led him to choose the profession of civil engineering, and on completing his studies he immediately secured a situation on the surveying corps of the proposed railroad between Hartford and Springfield, Connecticut, the lines for which were run in the middle of a rigorous winter, the engineers being exposed to the hardships of extreme cold and deep snows. On the completion of this survey he was retained by the engineer in charge, the late William H. Talcott, and transferred, in 1840, to the little town of Cuba, Allegany Co., N. Y., where he was placed in charge of a section of the work of enlarging the Genessee Valley canal, being engaged both in preparing estimates of cost and in supervising the practical construction. Mr. Whitney remained at this post more than two years, and was then transferred to Albany as private secretary to the same engineer.

In 1842, Mr. Asa Whitney removed to Philadelphia, having formed a partnership with Matthias W. Baldwin, under the name of Baldwin & Whitney, for the manufacture of locomotives. Mr. George Whitney was soon called to Philadelphia and was employed by this firm until its dissolution in 1846.

We next find him assisting his father, who had been appointed president of the Morris Canal Co., in the work of preparing drawings for the remodeling and enlargement of the canal, a work of considerable magnitude in those days, involving some bold schemes in the substitution of improved inclined planes for the old-fashioned locks, and which, by their successful operation, rescued the company from its financial embarrassments and placed it upon a paying basis.

The President's "Report to the Stockholders of the Morris Canal and Banking Company, March 17th, 1848," contains an interesting account of the experimental tests made January 27th, 1848, of the first inclined plane constructed under his supervision, in which he says that a boat containing seventy tons of cargo (exclusive of the weight of boat and car) was passed repeatedly up and down the plane, with great apparent ease and without employing more than half the power that had been provided. The boats were carried up the inclined planes at a greater velocity than they were towed on the levels, and the system then introduced is still in successful operation on the canal. The height of the first plane was fifty-one feet, its inclination one in ten; the whole distance that the boat was moved by machinery was 900 feet and the time employed was three and a half minutes.

Mr. Asa Whitney, realizing, prior to dissolving partnership with Mr. Baldwin, the great necessity for improvement in wheels for locomotives, tenders and cars, had devised a process for annealing wheels made of chilled cast-iron, for which he obtained a patent in 1848. The experiments, which were made chiefly by Mr. George Whitney, under his father's direction, proved so successful that Mr. Asa Whitney, foreseeing the opportunity

here presented of developing a large and profitable business, resolved to confine himself to this specialty; accordingly, in 1847, the firm of A. Whitney & Son was established for the purpose of manufacturing chilled cast-iron car-wheels under this patent. The extensive works covering the ground between Callowhill street, Pennsylvania avenue, and Sixteenth and Seventeenth streets, were erected a few years later, and were by far the finest and most substantial, as well as largest, devoted to this specialty in the country. As an evidence of the extent of the business it may be stated that about one and a half million car-wheels have since that time been made at this establishment and sent to all parts of the world where the iron horse has penetrated.

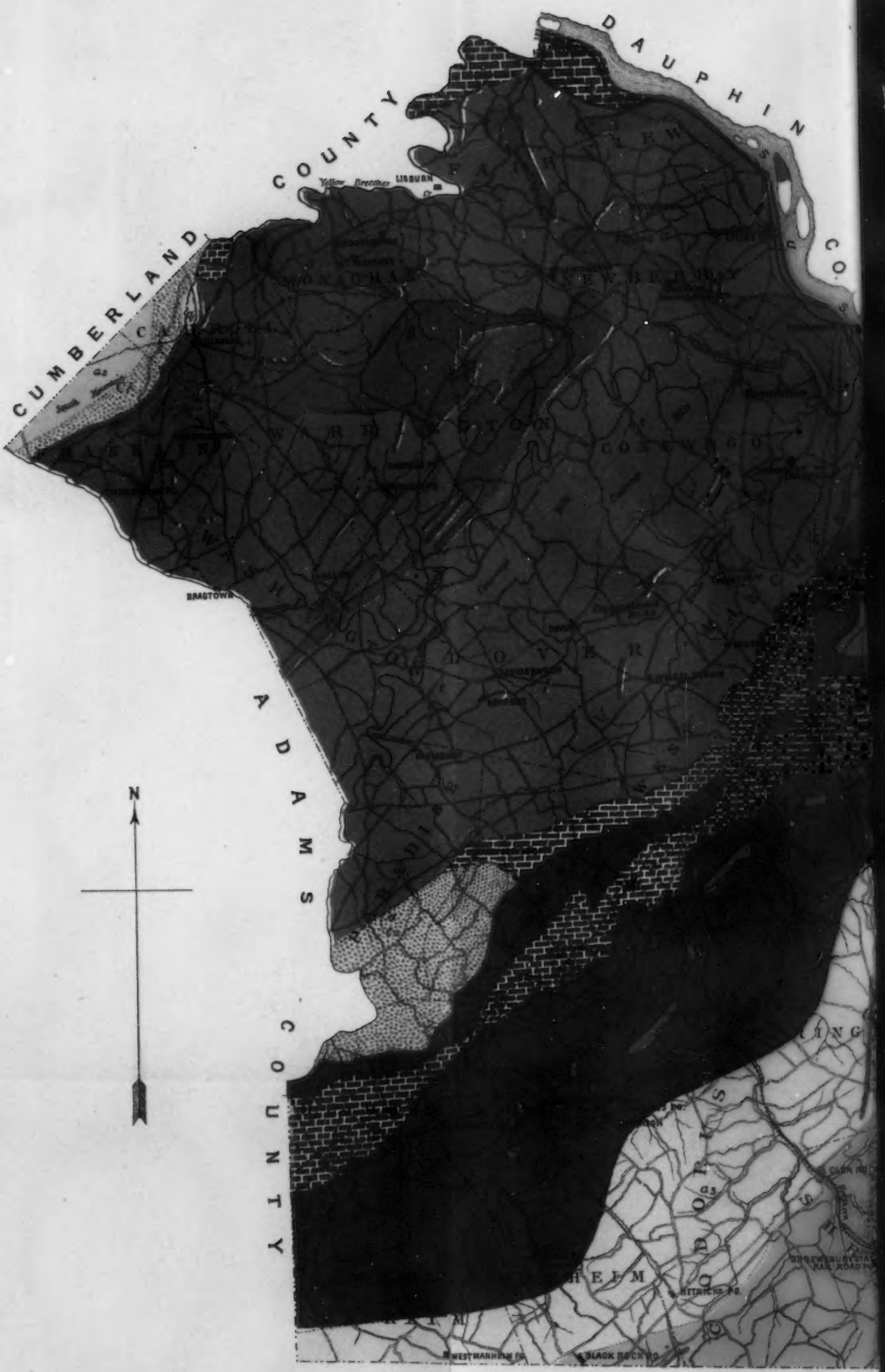
Mr. George Whitney devised many improvements facilitating this manufacture, and for several years prior to the death of his father, which occurred in 1874, he was the practical head of the firm.

Outside of this special occupation, Mr. Whitney was well known as a public-spirited citizen, giving aid both by his wise counsels and his generous contributions to all laudable objects. At the outbreak of the late rebellion he was one of the foremost business men in this city to recognize and accept the responsibilities thrust upon him and he never wavered for a moment, or lost courage in the darkest hours of the nation's peril; he was one of the original members of the Union Club, a liberal subscriber to and treasurer of the Bounty Fund, and he testified, in various other substantial ways, his loyalty to his country.

As a business man, Mr. Whitney's reputation was such that his counsels were eagerly sought by many of our largest moneyed institutions, and though failing health compelled him of late years to relinquish some of these labors he was still active in not a few such corporations. At the time of his death he was a Director of the Insurance Company of North America, The Philadelphia National Bank, The Philadelphia Saving Fund, and The Lehigh Coal and Navigation Company.

As an art patron, Mr. Whitney has done much to stimulate the higher education in art in this country, both by his judicious selection of foreign paintings of the highest order and by his generous encouragement of native talent; his collection of pictures is one of the choicest in the United States and is even better known in Europe than in this country. Mr. Whitney was, for many years, a Manager of the Philadelphia School of Design, a member of the Board of Trustees of the Academy of Fine Arts and of the Pennsylvania Museum of Industrial Art; he was also an honorary fellow of the Metropolitan Museum, and at the time of his death was one of the Board of Trustees of the University of Pennsylvania.

In private life Mr. Whitney was an exceedingly modest and unassuming Christian gentleman, generous to a fault, ever ready to assist the unfortunate, while carefully concealing his name and his good works from the public eye. He died on the sixth day of March, 1885, after an illness of several weeks.


CUMBERLAND COUNTY
DAUPHIN CO.
ADAMS COUNTY
LISBURN
BRASTOWN
N

GEOLOGICAL MAP
OF
YORK COUNTY

in the Colors recommended by the International Congress of Geologists at its third (Berlin.) Session.

Constructed by

Prof. Persifor Frazer D. Sc. (Univ. de France.)

Scale 4/10 Miles to 1 Inch. = 253770 Nature.

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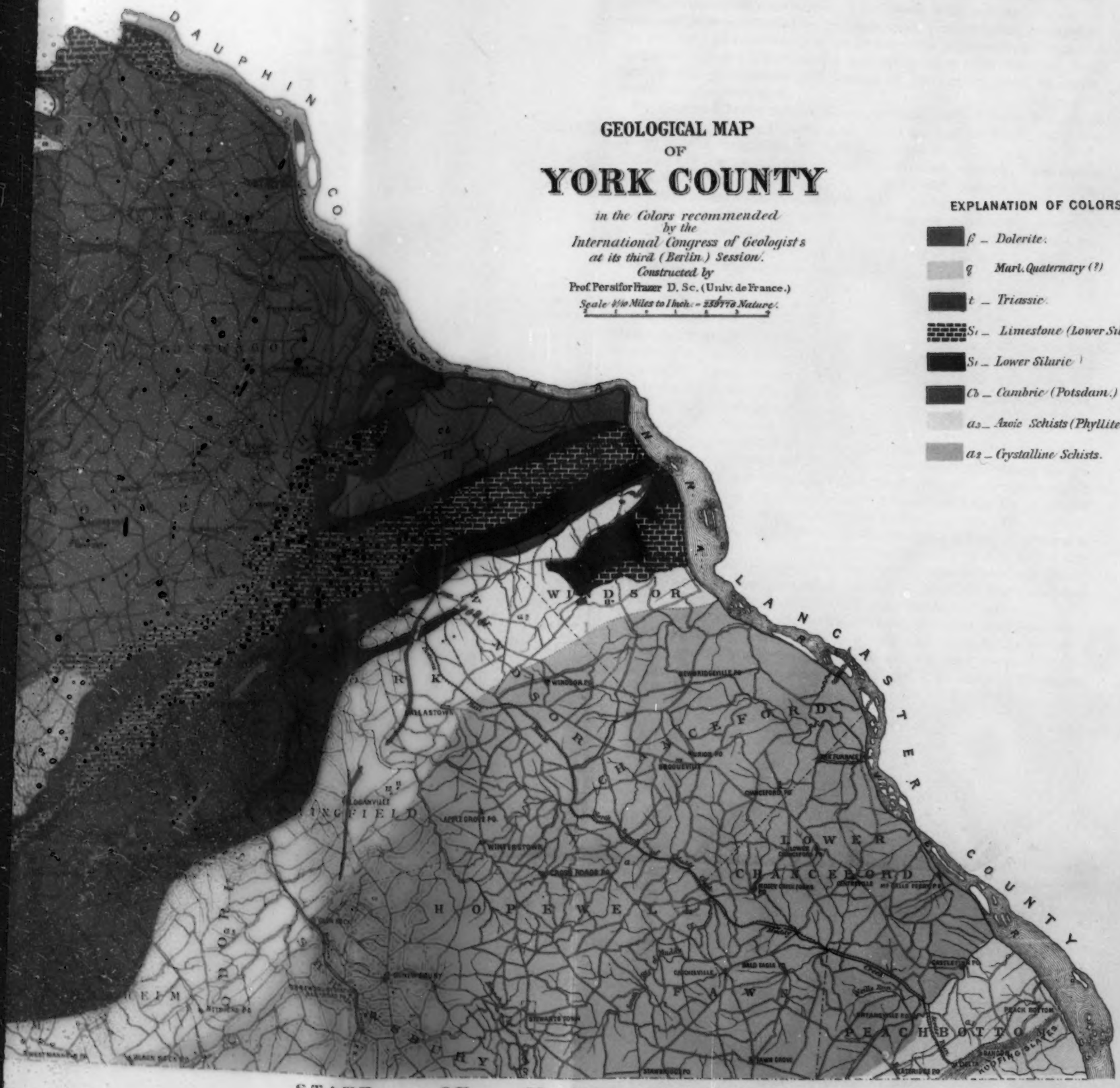

EXPLANATION OF COLORS

- β — Dolerite.
- q — Marl. Quaternary (?)
- t — Triassic.
- S₁ — Limestone (Lower Siluric.)
- S₁ — Lower Siluric.
- Cb — Cambric (Potsdam.)
- a₃ — Azoic Schists (Phyllites.)
- a₂ — Crystalline Schists.

STATE OF MARYLAND

GENERAL NOTES.—SKETCH ON THE GEOLOGY OF YORK COUNTY, PENNSYLVANIA.

By Persifor Frazer.

(*Read before the American Philosophical Society, December 4, 1885.*)

The conditions which make York county soil productive, the study of its geology interesting, and that geology itself varied, are due to effects of movement in early geological time, which, compared with those which have shaped our continent, are so small that they can hardly be represented upon a geological map of the United States of ordinary size. Yet, in a rough and general way, York county is a partial imitation, on a very small scale, of the United States, inasmuch as, like that part of the American continent, it consists of a belt of Archæan rocks in the north-west; of another in the south-east; and that its intermediate portions are made up of newer formations containing fossils. Cavities in the limestone containing lignite and fossil plants, the latter resembling that of the present day, are not rare. These and possibly a marl in Carroll township near Dillsburg, which, however, has yielded no fossils, represent the latest geological period; and thus it may be said that of the five great divisions of the rocks of our planet: viz, the "original" (?) or Archæan; the "old life" or Palæozoic; the "middle life" or Mesozoic; the "new life" or *Cainozoic (including under this head the Quaternary and Recent), and the Eruptive or igneous, each has a representative (or several of them) within the confines of the county. If it were of interest or profit, the analogy might be pushed a little farther to include the occurrence of the igneous rocks in the north-west; the broad belt of Mesozoic strata which abuts upon the Archæan (but, in the case of the continent, also upon numerous masses of new rocks which are scattered over a great part of their junction); the contact of the Palæozoic (Siluric in both cases) on the south-east border of the Mesozoic and the contact on the south-east of the latter formation with the Archæan. The last feature of the United States' geology, which fails in the case of York county, is the border line of New Life or Cainozoic rocks to the south-east of all the above formations; and even this might be supplied if the limits of the county were pushed a comparatively short distance across Mason and Dixon's line, and into the State of Maryland. But enough has been made of this fancy, which is only introduced in order to fix more securely upon the memory the fact that, geologically speaking, York county may be considered to be a part of a great accidented plain of which the general trend is east of north and west of south. Its valleys, or portions of them, have successively formed the ocean bottoms of four or five different geological periods, probably extending from first to last over many millions of years.

To Rogers' names of "Primal" (or the beginning); "Auroral" (or

* Written frequently Cenozoic.

the *dawn* of life); "Matinal" (or the morning. Same metaphor); "Surgent" (or rising), &c., to the lower divisions of the Palæozoic; and "Cadent" (or falling); "Umbral" (or darkening); "Vespertine" (or evening), &c., to the later divisions of the Palæozoic, the insurmountable objection is made that they do not describe any general state of facts. Thus it might be asked: Of what are these rocks the beginning, dawn, evening? Evidently of the second only of the four arbitrary and artificial divisions by age which geologists have constructed for their temporary convenience. The plan adopted by the New York geologists of giving a name to each formation, which should either recall the locality where it was characteristically displayed, such as the "Potsdam sandstone;" or describe it lithologically, as the "Calciferous sandrock," the "Marcellus shales," the "Oneida conglomerate," &c., would be a good one for provisional use, were it not that in addition to the geographical designation, a lithological definition is added, which, because restricted in the area to which it is applicable, is as often inaccurate as the *time* description of Rogers. Thus the "Potsdam sandstone" is a "Hellam Township quartzite," in York county, and Prof. Fontaine, of Virginia, thinks it represented by a peculiar schist containing quartz fragments in Virginia; and some persons are sure that it occurs in other places as a gneiss. The "Calciferous sandrock" of New York is the same formation which makes up the major part of the broad and fertile limestone valleys of Lancaster, York, Cumberland and Franklin counties, &c., where it is not a sandrock at all.

As there are various objections to every system yet proposed, I have adopted here that recommended by the International Congress of Geologists at its Berlin session.

The Archæan (or beginning) in this classification comprises those rocks, usually crystalline in structure, but of very varied and divergent character, in or below which the very earliest known forms of life occur—and those very sparingly—in York county. This series comprises all the rocks which are geologically inferior to the Hellam Township quartzite.

The Palæozoic (or "old life") includes all the rocks from and including the Hellam quartzite to the New Red sandstone, and is made up of the quartzite, hydro-mica schists, and their included iron ores, the great blue and buff limestone on which the city of York is built, together with that of Lower Windsor township; that near New Holland, in Manchester township; around Newmarket in northern Fairfax township; and north of Dillsburg in northern Carroll township.

The Mesozoic (or "middle life") rocks are the reddish-brown sandstones and shales (and perhaps the igneous rocks penetrating them) which cover almost the entire north-western part of the county. If the fancy might be indulged of likening the outline of the county to that of the lower part of a horse's leg, this formation would constitute the fetlock joint and all that portion immediately above the hoof proper.

The Cainozoic (or "new life") includes all those rocks of which the

origin is of later date than the last mentioned, but it is generally used for those before the date of any historical evidences of the appearance of man on the planet. It is not known to me that there is a representative of this age present: that marked "marl" in the geological map being introduced without the evidence of fossils so far as I know and with considerable doubt.

The Quaternary and *Recent* deposits comprise those deposits which have been made from the earliest appearance of man on the planet down to the present time, including of course those of origin so late that they might have been historical. Such are the marks of the denudation which has shaped the meadows and hills as they are at present; the moulding of the ravines and deepening of the stream-beds; the distribution along the latter of gravels, &c; and finally (for the sake of saving one more division of time, which would otherwise lie wholly within this one, and at best remain very uncertain as to exact date) the works of man's hand, which are discoverable in the arrow-heads and sculptures not infrequently observed along the lower course of the noble river which forms York's north-eastern boundary.

One word more is necessary as to the subdivision of the rocks of these different geological ages before their occurrence in York county becomes our theme.

It has been said that if the average thickness of all the strata which have been yet recognized as distinct in the State of Pennsylvania were laid one upon the other, the height of the pile would reach something like forty thousand feet. But this is made up almost without taking into account other than the Palæozoic rocks. If the ordinary methods of calculation were pursued in estimating the thickness of the Mesozoic or New Red sandstone and shale alone which crosses York county, three miles and a half would be added to this column.* No very great thickness of Tertiary or Cainozoic rocks is to be found in Pennsylvania, but if, instead of counting upwards, or from the most recent of the Eozoic series, we were able to count downwards to its lowest member; or to the earliest existing rocks of the globe, it is probable that a thickness of this series alone greater than all of those that we now know put together would be established. That the exposures of rock in York county will not justify the belief that any considerable fraction of this Archæan series can be reached by boring, the following list of its divisions, accepted by many geologists, will sufficiently show. They are given in descending order, the lowest being the earliest known, and the first named the most recent:

VI. Keweenian.†	III. Huronian.
V. Taconian.	II. Norian.
IV. Mont Alban.	I. Laurentian.

*There are, however, good reasons for rejecting such an estimate.

†See volume E, p. 241, Publications of the 2d Geological Survey of Pennsylvania, by Dr. T. Sterry Hunt.

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The Archæan Rocks of York County.*

Crystalline Schists (a_2).

I have not seen in York county any rocks which I considered to be of Laurentian age. If there be any, they are to be sought in the portion of the South mountain, which is included in parts of Carroll and Franklin townships, but it is very improbable that any will be found there. The same may be said of the Norian, which is simply another name for what was once called "Upper Laurentian." There remain then only the Huronian, the Mont Alban and the Taconian, for the Keweenian is not known in this part of the United States. The lowest member of the Archæan series, which has been recognized in York county is the Huronian, and if I be not in error, the rocks of this age form the greater part, if not all, of its lower strata. On the accompanying geological map it is colored a pink of medium tint, and lettered "a_2," as well as all that previously referred to in Carroll and Franklin townships forming the South mountain.

Crossing the Susquehanna somewhat obliquely a broad flat arch of these rocks becomes evident in plotting the observations on section lines along either the right or left bank of the river.†

The perpendicular thickness of the Huronian rocks which constitute the visible parts of this arch has been calculated by me to amount to fourteen thousand four hundred feet, or 2.7 miles (or 4.3 kilometers), measuring from the lowest rocks exposed a short distance above McCall's Ferry to the base of the Peach-Bottom slates. This arch (or anticlinal) is a very important feature in the geology of this part of the State; for it is not improbable that it is the leading element in the structure of a broad belt of rocks extending from a point at least north of the Schuylkill river (and not improbably even within the New England States) to and into the State of Alabama.

But whether this carefully considered hypothesis be true or not, there is not the slightest reason for doubting that the rocks of this part of the county form the floor on which all the others in the county were laid down. Another fact in relation to this flat arch or anticlinal remains to be considered, viz: the line along its crown (or along the top of the arch) appears not to have been an horizontal line after the last great earth-crust movements, of which we can find evidence in this part of the continent, had been completed; the *axis* of this arch appears to have sloped upwards, from the west of south to the east of north; and to say that this axis rises towards the north-east, is to say that, judged from our present surface, the lower (and consequently older) beds of this arch rise nearer to that surface, the farther one follows this direction of north-east; and of course these same rocks sink lower beneath the surface

*See Note 7 at the end.

†See these sections by the author in atlas accompanying volume CCC, 2d Geological Survey of Pennsylvania.

the farther one follows the direction of the arch to the south-west. I have elsewhere given reasons for the hypothesis that this anticlinal joins and continues the anticlinal of the Buck Ridge* near Conshohocken, a few miles north-west of Philadelphia, on the Schuylkill river, traversing Lancaster and Chester counties, a little south of the Chester valley. But at Conshohocken, the anticlinal is represented by Laurentian gneiss, while in Lancaster and York counties, the Huronian schists, which have been torn off by atmospheric denudation at the former locality, still remain; and still farther to the south-west it is not unlikely that even more recent sheathings may be found, unless the axis be broken or bent, and rise also in this direction. The main fact, which it is my purpose to emphasize here, is that the same structure of arch evidently affects an enormous thickness of beds; in all probability is traced in the flexed rock masses of at least two entirely different geological periods, and may possibly be discovered in those of yet others outside of the limits of the field which it is my purpose to describe.

A somewhat arbitrary division has been made by the writer between the rocks of the Huronian and those of the next following age. The line which constitutes this division may be seen passing through the southern part of Lower Windsor, the middle of Windsor, the eastern part of Springfield, including Codorus, and reaching the Maryland line a short distance east of the boundary dividing Manheim from West Manheim township. This line does not profess to be, and in all probability is not an accurate line of demarcation between the two formations. It was adopted as an approximate dividing line between two regions which exhibit lithological characteristics diverging from each other in a degree proportional to the distance on either side of it. The same is true of the line which separates these lower rocks from the triangular area in the extreme south-eastern corner of the county, in which are found the famous Peach-Bottom roofing slates. These two lines, which are in the average parallel to each other, are approximate boundaries only between the two regions, and that filled by the rocks of the McCall's Ferry or Tocquan Creek anticlinal. The rocks of the latter belt are strongly marked crystallized rocks,† *i. e.*, their structure is coarse, and the minerals which compose them are large and well crystallized, especially along the central parts of the belt. The rocks of the two bordering regions just mentioned are more crystalline, *i. e.*, crystallized imperfectly or in much smaller masses, besides having other differences in kind. For example, the arch-belt (if I may be permitted to express it so), contains larger amounts and larger specimens of Muscovite, and more potash micas generally. The rocks are lighter, and not infrequently enough feldspar is found to give them a decidedly gneissic character; and the more so in general terms, the farther one gets away

*See "Thèses presentées a la Faculté des Sciences de Lille. Université de France," &c., 1882, and "History of Lancaster County," &c., Phila., Everst & Peck Publ., 1883, p. 3.

†See note at the end.

from the bordering regions. The rocks in these latter regions, on the other hand, are more and more magnesian, darker in color (usually greenish or yellowish-green) and softer. They contain large quantities of chloritic minerals, and are remarkable for the great number of white quartz dykes which intersect them.

These "arch-rocks" are very generally destitute of valuable minerals, so far as they have been explored in York county, except on the fringe of the South mountain, where they are in close proximity to a series of iron ore deposits similar to and in fact continuous with those known as the ores of the "Great," or "Cumberland Valley." But though this juxtaposition would tempt one to connect these ores with the rocks just spoken of, and though it is conceded that rocks of this age do often carry iron ores, the strong probability is that the proximity is "accidental," that is to say, that the ores occur at the foot of the mountain, because having been originally imbedded (as constituents of minerals) in the rocks which covered these slopes during the degradation and destruction of these latter they have been disintegrated, carried away from their original place (sometimes not far off), and segregated in the soft and unctuous clays to which these loose beds have been reduced. But it is not improbable that some of these ores may have owed their origin to the same kind of alteration taking place within the mass of the Huronian rocks themselves. So that wherever the loose débris of higher formations (and notably of the Hellam quartzite (Potsdam sandstone), which everywhere abounds on the slope in boulders and blocks) will permit the undoubted Huronian to appear near one of these great iron mines, it is likely to be found that a part of the wealth of the latter consists in a somewhat peculiar ore unlike the rest, which can be traced to its first resting place within the bosom of the Huronian rocks.

The belt of rocks which represents the Archæan in York county, lies, as it may be said approximately, between two lines, one following Muddy creek from its mouth in the Susquehanna to its right-angled bend, and thence through Bryantsville to Constitution; and the other commencing opposite Turkey hill (in Lancaster county), and passing north-west of Windsor post-office, south-east of Dallastown, and nearly through Glen Rock post-office. The portion of the South mountain above referred to as belonging to the same age is small in area within the county limits, and occurring at one end of the chain of crystallophyllites where they appear to sink beneath the newer limestones and shales; its slopes are gentler; it has been subjected to greater erosion, and is covered for the most part with the débris of more recent formations. This belt, thus defined, contains no minerals which are yet mined (if we except the iron ores from the category), but the soil formed by the chemical and mechanical action of the atmosphere on its rocks is next in fertility to that of the limestone belt itself. The rocks of the Archæan belt, thus defined, are intersected by but few igneous dykes or trap, and this fact, taken in connection with the remarkable prevalence of such dykes in the north-western part of the county,

and their frequency throughout the middle belt of limestone and schists, would lead one to conclude either that the seats of the igneous action resided within the beds of the newer rocks, or that the superposition of the latter in some way favored the development of the Plutonic forces which have forced molten rock for miles through narrow crevices and cracks in the envelope of the globe. Perhaps the explanation may be found in the supposition that the number of such dykes would depend upon the number of fractures in the earth's crust, and that this number would increase with the growing weight due to thickening sediments deposited by water. However this may be (and it does not explain all of the facts connected with the new red sandstone), the only points where have observed trap penetrating and terminating in the rocks of this belt are: First, in a small exposure north of York Furnace on the Susquehanna, and second, a short distance east of Black Rock post-office.

The Belt of Azoic Schists or Phyllites (a_2).

I have preferred to describe this belt under a separate heading, because there are difficulties connected with its assignment, either to that part of the Archæan rocks just considered, or to the Palæozoic which will next be described. These difficulties arise in great part from the lack of outcrops of "rock in place." The decomposition which has attacked this intermediate belt has destroyed the identity of the individual beds and strewn the surface with its products, which are mingled with the remains of rocks of much later date. This is not surprising if we may assume that this belt formed the upper and later portions of the great Archæan series, for we have abundant proof that in contrast to the stability and repose of the broad flat arch to the south-east, this new region was the hinge on which the first of a number of severe plications of the strata were operated. This bending and twisting unquestionably crumbled the rocks and left loose material which was easily moulded by the waters of the ocean, which then or subsequently covered it, to forms which more or less resembled those which had originally characterized it. But after its consolidation with the next succeeding formation, and after an unknown amount of erosion had laid bare their contact line, both were together similarly treated, so that in the contorted state in which it was left it exhibits some features which recall the Middle Archæan, and others which remind one of the Lower Palæozoic of the county. Its precise boundaries being difficult to ascertain on the ground, cannot be given with precision in the text. It will suffice to say that, beginning on the Susquehanna river, a short distance south of the southern outcrop of the Prospect limestone, one part of it occupies all the region lying between the north-western boundary of the Archæan already given and the southern and eastern limits of the Hellam quartzite shortly to be described. It is traversed through part of its extent by two large trap dykes, and contains numerous deposits of iron ore which I am disposed to ascribe to segregation from iron minerals in other formations. Some limestone occurs interbedded with these rocks

(as at Glen Rock), which may be safely assumed to be of earlier date than the important York limestone, whether or not it be (as seems not improbable) a part of the regular Huronian series.

The most extensive iron ore banks noted in or on the border of this intermediate belt are the Brillhart and Feigley banks marked Nos. 11 and 12 on the map.

The Peach-Bottom district, including the roofing slates lying to the south of the flat arch, was described by me in volume CCC, Second Geological Survey of Pennsylvania, in 1877, where I showed that its position in the series was doubtful, and that these rocks might be interpreted to represent the Upper Archæan (a_3) (below the Potsdam); or the schists immediately above the Potsdam (s_1); or (by supposing a fault), a formation still higher—the "Matinal" of Rogers. Since then fossil algæ were furnished to Prof. James Hall from the quarries, but he was unable to determine the age of the rocks from them with greater precision, than to refer them to the second or third of these horizons, with a preference to the second.* Photographs of the quarries and of the manner of working them will be found in volume CCC, Second Geological Survey of Pennsylvania.†

The Palæozoic Rocks.

Cambric (Hellam Quartzite, Potsdam Sandstone). (cb)

Prof. H. D. Rogers, in the First Geological Survey of Pennsylvania, marked out and described the members of the different formations represented in the State. This formation, which we may consider the base of the Palæozoic, was considered by him to consist of three parts: a lower series of "talcose" slates, a middle white sandstone, and an upper series of talcose slates. It will be easily understood, by what has just been said, to what extent the view here offered differs from that of our great pioneer geologist. These "lower talcose slates," in all probability, are identical with the Azoic schists (or phyllites) just described, and, therefore, their position relatively to the beds beneath them and above them is the same, whether they be considered Upper Archæan or Lower Palæozoic. There are no good exposures of the Hellam quartzite with the slate below it at any place in York county which I recall. On the flank of the South mountain, the quartzite is very much rent and crushed into fragments, while of the small patch on the map about two miles west of Case's ore bank (No. 8 on the map) no accurate dip was recorded. The Hellam quartzite, of which a part composes the "Chikis mountain," exhibits, indeed, in its numerous foldings the rock, called by Rogers, "talcose slate," between its two principal beds of quartzite, but not appreciably lower than the latter. We are forced to look to other parts of the country for a clearer knowledge of the relation to each other of this quartzite, and the schists on which it rests. We find abundant instances

*See Peach-Bottom slates of S. E. York and S. Lancaster counties, Proc. Am. Inst. of Min. Engrs. Troy meeting, 1883.

†See note No. 2 at the end.

of this contact in Chester county north of the valley of that name, and in all of them the quartzite lies "uncomformably" (*i. e.*, with changed dip) upon the schists. The latter, it is true, are somewhat different in minor characteristics from those of which it is here the question, but so also is the quartzite. Yet we have the best reasons for believing that each is of contemporary origin with its analogue in York county; and indeed, the differences, which would not be considered at all important by any but a critical geologist, are what we might expect when we remember that these rocks are sediments laid down at the bottom of successive seas, and that their characters depended upon the kind of material which different streams draining different parts of the country brought down to be strewn out at different localities during different epochs.*

It will be explained before long that the physical break between the Archæan schists and the limestone series is rendered highly probable by the observations in York county, but that between the flat arch belt and the Hellam township quartzite must rest upon the direct evidence obtained in other counties, unless here also we may apply the indirect method mentioned above, and conclude that inasmuch as the Hellam quartzite contains one important fossil (*Scolithus linearis*) and the Archæan schists contain none that have yet been discovered in York county, this fact alone entitles them to be considered different formations.

The Hellam or Chikis quartzite is a hard quartzose rock, of which the general color is white or gray, tinted by some other color, usually pink, brown or blue, depending upon the minerals with which it has been associated. It is almost always crystalline, and in disturbed regions like this is most frequently found in broken fragments rather than in continuous beds. This is probably owing to its brittleness, which prevented it from yielding gradually to the strain which has folded and tilted the other rocks of the county. These strains have twisted, broken and crumbled it, but on account of its great hardness and its resistance to the chemical action of the atmosphere, it is the least altered or decomposed of all the rocks to be considered here, and almost always indicates its presence by a hill, whatever be the position of its strata.†

It is not necessary to specify the localities within the county where this quartzite occurs, because they are indicated by brown on the accompanying geological map; still less is it desirable to discuss here all the possibilities of structure which these scattered outcrops suggest. It is important, however, before leaving the floor of the Palæozoic column, to say that eleven years of experience in the field have caused me to doubt the cor-

* Let any one observe the great differences between the characters of the sand beach of our own Atlantic coast within short distances. See on this subject Delesse's important contribution entitled "Géologie du fond des mers," and the writer's notice of the same in the Proc. Am. Philos. Soc.

† Of course the reason of this is that the erosion, which has torn off hundreds and perhaps thousands of feet of the other measures, has not been able to reduce it to the same extent, and it remains, consequently, as an elevation, or chain of hills.

rectness of ascribing to this formation the iron ores which are found in the schists immediately above the quartzite.*

The Grubb ore bank (No. 111 of the map) is the only one which lies wholly within the area of the Hellam quartzite as given on the map, but a reference to the description of this bank (Vol. C, p. 64, 2d G. S. of P.) leads to the belief that the larger part of the ore lies in a small remnant of the bottom schists of the next higher formation, which has escaped the erosion that cut off the higher layers of that formation. Part of it, however, answers to the description of an iron ore which may really belong to the quartzite and which has been noticed in the rocks forming the outer casing of the South mountain.†

Siluric. (s)

The York Limestone and Schists (*Auroral* of Rogers, in part the *Calciferous Sand rock* of the New York Survey). This important member of the Palæozoic series in York county consists of at least two, and perhaps three, distinct kinds of rocks, and inasmuch as the kind that occurs at the bottom (which resembles strongly that which occurs among the limestone beds themselves, and also above them) has already been mentioned several times by anticipation, it will be advisable to consider it first.

Hydro-mica Schists. (s_1)

It was previously stated that Rogers, and following him, almost all other writers on geology up to the commencement of the Second Geological Survey of Pennsylvania, had given the name of "talcose slates" to a group of rocks which he connected in epoch with the quartzite. The word talcose was applied to them because from their softness and greasy feel it was assumed that they were largely composed of "talc;" but subsequent investigations of these rocks in the chemical laboratory have shown that they contain little or no magnesia, and that they derive their peculiar characters from large amounts of a group of micas containing potash or soda and water. Prof. James D. Dana conceived the happy thought of naming the group the "Hydro-micas" (or water-containing micas), and naturally the rock which is mainly composed of them is called Hydro-mica schist.

These hydro-mica, or nacreous schists, are not of uniform appearance. Sometimes, and especially in the beds that underlie the limestone, they are firmly compacted together, making hard rock masses and high hills, as at many places along the Susquehanna, from Wrightsville to Cabin Branch run, and elsewhere in the county. Sometimes they are so much disintegrated as to form dust, which on close view is seen to be mainly

* Of course, if the Potsdam have an upper member consisting of schists, the above assignment is correct; but I know of no instance in which the opposite supposition is not equally supported by the facts. It is also to be noted that the limestone and iron-ore bearing schists are more frequently found together without the quartzite, than the quartzite and schists without the limestone.

† Cottrell, Benson's and Smyser's mines (Nos. 11 and 112) are on the border line between the quartzite and limestone.

made up of little glinting particles. In the former case the beds are very often strewn with pyrite. Again, in place of these crystals of iron—and occasionally copper—sulphide, are beautiful casts or moulds of the shape of a cube, more or less filled with a dark brown iron rust obtained from the decomposition of the original crystals. These little crystals have been of no small importance to the prosperity of York county, for there is good reason for believing that by far the largest part of its iron ores have been derived from their oxidation, transportation by water and final deposition in the clays formed from the grinding up of the rocks which originally contained them.*

These argillites, or limestone schists, as I have sometimes called them, in all probability hold all the important iron ore† mines of the county, outside of the formation of red sandstone and shales. It is true that sometimes the iron ore banks appear to be far from the area colored as limestone, and sometimes directly within the boundaries of that area, but in neither case is it under conditions that forbid the belief that they are in the veritable hydro-mica schists, even if the latter may have been reduced by the weather to soft unctuous and variegated clays. It is not assuming too much, therefore, to call this portion of York county rocks the real iron-bearing region. The edges of the rock appear in the right bank of the Susquehanna river, where that river has cut through them, and one would select the part just above Wrightsville to ascertain whether these schists were unconformable upon the quartzite; but the following records of the dip, or inclination of the two rock series taken from section 1 of my report on the county,‡ will show that both formations are so flexed or twisted, that no certainty can be obtained there. First, there are two dips in the Quartzite of South—50°, and almost at the contact with the schists S. 20°, E.—45°. Next there are three dips in the schists which are respectively S.—45°, S. 10°, E.—50°, S.—10°, E.—10°. Still, there is every probability that in fact the dips of the two differ, both in direction and amount, while there are no such indications for the dips of the schists and of the limestone proper at this place.§ These schists are colored dark-green in the accompanying map.

The York Limestone with Argillites.—One of the best opportunities of measuring the thickness of this limestone is afforded by the section referred to along the Susquehanna from a little run half a mile above the Columbia bridge to Creitz's creek. This is evidently a trough with the axis close to the bridge, and measures 2800 feet of limestone and included schists. If the schists between the quartzite and the limestone be included, it would add some 1600 feet to this, making the limestone

* See Volume C, p. 137, 2d G. S. of Pa., by the author.

† See Note 3, at the end.

‡ Vol. C, p. 78.

§ In the section above referred to it is probable that a further study would enable me to abandon the hypothesis of non-conformability at *g*, *i*, *k* and *o*, which I considered necessary eleven years ago.

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and the schists below it to the quartzite 4400 feet thick. The same beds measured by me in Lancaster county only amounted to 3400 feet. These beds, therefore, thicken 1000 feet in the twelve miles which intervene between this section and the city of Lancaster, and of this thickening 400 feet belong to the schists below the limestone and 600 feet to the limestone itself and its included schists.* The limestone, of which numerous analyses will be found in Reports C, CC, CCC, M and MM, is dolomitic, that is to say, it is a carbonate of lime, containing varying amounts of carbonate of magnesia. There is also some ground for believing that two kinds of limestone are represented, each having its own peculiarities of physical structure. It was noticed in many cases that two kinds of limestone were often exposed in the same quarry, and that they usually showed slight variations of dip. One, which was apparently the elder, was of a buff or grayish color, and less marked stratification; the other blue, with white streaks and spots of lighter colored limestone (often calcite). One case was recorded where, in a contact between the two, pebbles of the buff were found in the blue. There seems no doubt that the great mass of limestone now under consideration was formed subsequently to the quartzite, and at about the epoch of the Calciferous Sand-rock of New York and before the Trenton, or in other words in the Canadian epoch of Dana. But no fossils were found in the county to settle the question. The portions of the beds connecting the limestone near New Market with that of York (a connection which doubtless exists), is covered up by the beds of the Mesozoic. Those which once connected that of Wrightsville with that near Prospect has been washed away in the general planing down of the surface by erosion. The limestone is indicated in the map by white line blocks through the dark green.

The Mesozoic Rocks in York County.

None of the numerous members of Mesozoic rocks is known to be represented but the groups of sandstones and shales known as the "New Red Sandstone," and sometimes the "Triassic Sandstone."

There are many puzzling questions which arise from the study of these rocks, not the least of which is their thickness. If one assumes them to lie naturally without distortion, layer upon layer, in York and Adams counties, their perpendicular thickness in this region will be not less than sixteen thousand four hundred feet.† The lower bed of this formation,

*See Note 4, at the end.

†See Volume CC, 2d G. S. of Pennsylvania, p. 303, by the author. See also by the same "The American New Red Sandstone." Trans. A. I. M. E.; "The Mesozoic formation in Virginia," by C. J. Heinrich; Trans. A. I. M. E., Feb., 1878; Notes on the Mesozoic of Virginia, by Prof. William M. Fontaine, Am. J. of Sc., January, 1879; and "Some Mesozoic ores," Proceedings American Philosophical Society, April 20, 1877, by the writer. In the article cited second, and in a review of the others in the *American Naturalist* for May, 1879, I have shown that by calculating the thickness of Prof. H. D. Rogers' Yardleyville section of this formation (First Geological Survey of Pennsylvania) by the ordinary method, the thickness of beds would appear to be 51,500 feet, or nine and three-quarter miles.

which forms its eastern boundary, is very generally a conglomerate of the older limestone pebbles, forming Mesozoic rocks. This can be observed about two miles west of York, at Beeler's Cross roads (Vol. C., p. 92, Sec. 2a).

The upper bed seems to be also a conglomerate which forms its western boundary on the slope of the South mountain. Rogers was in doubt, whether the so-called "Potomac marble" was represented by the upper or lower of these (see Report CC., p. 265). Borings with the diamond drill by Mr. Heinrich, recorded in the paper above mentioned, show that no such thickness exists in point of fact as one might conclude from the appearance of the beds, and the probability is that the actual thickness there is not above fifteen hundred feet. No such borings have been made in York county, but the probability is that this thickness is not very greatly exceeded. But these measures in York county are chiefly interesting on account, 1st of their fossils; 2d of their iron ores; and 3d of their coal. From the former Prof. E. D. Cope was able to assign the beds containing them to the middle and upper divisions of the Triassic. The coal which is found about three-quarters of a mile north of Liverpool on I. Spahn's farm, and elsewhere, represents the extensive deposits known as the Richmond Coal fields, which have been wrought for a century in Virginia to advantage, and are so still. Although its analysis indicates it to be a good bituminous coal (see CCC, p. 259*), yet it has never been found in Pennsylvania in paying quantities.

Copper, and other valuable metals have been similarly observed in this formation, though in disappointing quantity, in this county, though they have supplied furnaces in other parts of this State and in other States. The richest deposits of these metals are usually found near the borders of the formation. For the following summary of the Triassic fossils as yet determined in Pennsylvania I am indebted to the kindness of Prof. Cope.

The vertebrate fossils from the Triassic beds of Pennsylvania have been obtained principally from two localities by Mr. C. M. Wheatley. The longest known is the tunnel of the Reading railroad at Phœnixville; the other is in York county.† The species represented belong to the Fishes, Batrachia and Reptilia, as follows:

Fishes.

Turseodus acutus Leidy.....,Phœnixville.

Batrachia.

Eupelor durus Cope.....Phœnixville.

Reptilia.

Belodon priscus Leidy.....York Co., Phœnixville.
" *carolinensis* Emmons.....York Co., Phœnixville.
" *lepturus* Cope.....Phœnixville.

*See Note 5 at the end.

† About two miles north of west of Emilysville and one and a half miles from the south-eastern border of the Mesozoic.—P. F.

Palæosaurus fraserianus Cope.....York Co.
Suchoprion cyphodon Cope.....York Co.
" *aulacodus* Cope.....York Co.
Clepsysaurus pennsylvanicus Lea.....Phœnixville.
" *veatleianus* Cope.....York Co.
Palæoctonus appalachianus Cope.....York Co.
Thecodontosaurus gibbidens Cope.....York Co.

Total, twelve species, most of which are described in the Proceedings of the American Philosophical Society for 1877.

Of the above, the genera Belodon, Palæosaurus and Thecodontosaurus are typical Triassic forms. The first and last named are the most clearly determined. Belodon is characteristic of the Keuper in Europe. As the species found in North Carolina and in New Mexico (*B. scolopax* and *B. buceros* Cope) are characteristic members of the genus, I have identified their horizons with the Keuper. The specimens from Pennsylvania are not so perfect as from the other localities, but are not separable from them. Thecodontosaurus belongs to the base of the Keuper (Etheridge).

No vertebrate remains indicating the existence of the Muschelkalk have yet been found in North America.—*E. D. Cope.*

Iron Ores. What has been said of the copper and other metals, may here be said of the iron ores. Although an immense amount of iron must have been consumed in providing these beds with their characteristic red color, and in fact large quantities of thin oxide scales are to be observed almost everywhere between the strata; the only localities where iron ores appear to have been found in any abundance or permanence are: 1st, those near the margins of the New Red Sandstone, when it overlies another formation containing iron ore; and 2d, in the neighborhood of the trap dykes, which contain over 11 per cent of oxide of iron.* In the former case, it is extremely probable that the deposits of the older beds (as on the flank of South mountain) have been torn up by the agitated waters which laid down the Triassic rocks, and redistributed as part of the latter. In the other case it is very probable that after the decay of the exposed portions of the Trap, part of their iron oxide contents was concentrated by natural water-flow, and carried into the cavities and seams of the porous Mesozoic rocks. The Traps, probably, not only supplied the original material for these ore beds, but in addition protected them from being washed away, and new outbursts of molten rock very likely gave them their altered appearance and magnetic character.

The Trap. Though the trap cannot be said to be of the same age as the Triassic (since it cuts through the highest beds and therefore appeared clearly after the latest sedimentary bed of the Mesozoic), still there is no sense. The most interesting features of the York county trap are its appearance sometimes as dykes cutting through narrow clefts of the rocks, and sometimes as mesas, or "tables" covering large areas after having

*See Note 6 at the end.

been poured out from a comparatively small vent. One of these may be seen in Warrington and one in Monaghan townships. The chief constituents of this rock are pyroxene (or augite) and labradorite. Magnetic oxide of iron is always, and apatite is very generally present. The trap in Warrington is directly connected with the mass in and to the east of Gettysburg, and is identical in composition with the so-called "Gettysburg Granite."* The Triassic is represented by a medium tint of violet on the map.

Cainozoic. Of these, including the Quaternary and Recent, the only representatives are the marl bed north of Dillsburg, (?) and the gravels, fluviatile deposits, and Indian sculptures on the banks and islands of the great river. Full descriptions and phototypes of these latter will be found in Vol. CCC, 2d Geol. Surv. of Pa.'s publications. Though in strict accordance with the determination of Prof. Cope, just given, it should be represented perhaps as t3, which is a violet of very light tint. No rocks answering to the description of the shell limestone or "Muschelkalk," which constitutes the middle Trias of Germany and France, have been found in Pennsylvania at least. Pending the establishment of a parallelism, I have adopted the plan suggested by the International Geological Congress, of coloring the entire area as if it were the middle member of the formation.†

Analyses of Ores, Rocks, Minerals, &c.

Note 1. An analysis of a mica schist with imbedded crystals from half a mile N. W. of Cully's station, Columbia and Port Deposit R. R., is added here for comparison with that of the Beach-Bottom slate which follows: (No. 1705 in Survey's catalogue of specimens, CCC, p. 271.)

	P. C.
Silica (SiO_2)	59.01
Titanic oxide (TiO_2)	1.34
Phosphoric oxide (P_2O_5)	(traces)
Alumina (Al_2O_3)	17.02
Iron sesqui-oxide (Fe_2O_3)	7.76
Ferrous oxide (FeO)	2.64
Manganous oxide (MnO)	0.96
Lime (CaO)	2.08
Magnesia (MgO)	0.07
Potash (K_2O)	2.63
Soda (Na_2O)	2.44
Ignition	4.42
Total	100.37

The rocks of which the above is an analysis correspond with those be-

*See Note 6 at the end.

†The above paper was rewritten from one intended for a history of York county. Some matters not entirely adapted to a paper in the Proceedings, but which were difficult to eliminate, still remain.—P. F.

tween Centreville and Castle Fin in York county, not far to the north-westward of the Peach-Bottom district.

Note 2. Peach-Bottom slates. Mr. Andrew S. McCreath gave the following report of a specimen of the Peach-Bottom slate taken from J. Humphrey & Co.'s quarry half a mile east of Delta, York county (p. 270, CCC).

	P. C.
Silicic oxide (SiO_2)	55.880
Titanic oxide (TiO_2)	1.270
Sulphuric oxide (SiO_3)	0.022
Alumina (Al_2O_3)	21.849
Ferrous oxide (FeO)	9.033
Manganous oxide (MnO)	0.586
Cobaltous oxide (CoO)	(trace)
Lime (CaO)	0.155
Magnesia (MgO)	1.495
Soda (Na_2O)	0.460
Potash (K_2O)	3.640
*Carbon (CO)	1.794
Water (H_2O)	3.385
Iron bisulphide (FeS_2)	0.051
Total	99.800

Note 3. The following analysis of two different kinds of ore from York county are given. The first is from the "Lower Auroral," or limestone schists. It is from Earley & Killinger's Mine two miles and one-half east by north of Littlestown. It was analyzed by Mr. McCreath (See C, p. 44).

	P. C.
Insoluble residue	12.320
Iron sesqui-oxide (Fe_2O_3)	67.000
Alumina (Al_2O_3)	0.950
Manganese sesqui-oxide (Mn_2O_3)	2.341
Phosphoric oxide (P_2O_5)	2.804
Sulphuric oxide (SO_3)	0.277
Lime (CaO)	1.680
Magnesia (MgO)	0.591
Water (H_2O)	11.890
Sum	99.853

In the above there were

Metallic Iron	46.900
" Manganese	0.815
Sulphur	0.110
Phosphorus	1.224

* Average of three determinations.

The following is the result of an analysis of the Mumper mine in the Mesozoic sandstone, one mile north-east of Dillsburg (C, p. 71.)

	P. C.
Ferrous oxide (FeO)	18.643
Ferric oxide (Fe_2O_3)	42.100
Pyrites (FeS_2)	4.093
Copper sulphide (CuS)	0.098
Cobalt sulphide (CoS)	0.766
Alumina (Al_2O_3)	2.417
Manganese sesqui-oxide (Mn_2O_3)	0.186
Lime (CaO)	6.132
Magnesia (MgO)	6.738
Potash and Soda	0.350
Phosphoric oxide (P_2O_5)	0.052
Sulphuric oxide (SO_3)	0.119
Carbonic acid (CO_2)	1.760
Water (H_2O)	1.080
Silica (SiO_2)	15.120
Sum	99.654
Metallic Iron	45.880
" Manganese	0.129
Magnetic Oxide of Iron	59.040
Ferric oxide	1.703
Sulphur	2.680
Phosphorus	0.023

Note 4. In MM, p. 344, Prof. Lesley gives some analyses which derive their interest from the fact that they are very numerous, and all from a comparatively small thickness in the Walton limestone quarry opposite Harrisburg. His paper in the Am. Phil. Soc. was presented Dec. 20, 1877, but the article just referred to is dated June 23, 1879. From analysis of 115 layers of the limestone exposed in the quarry, it appears

	P. C.
That the Carbonate of Lime constituted	80.662
" " " " Magnesia constituted.	14.215
The insoluble residue constituted	4.715

Those proportions will give a better idea of the average constitution of the good merchantable York and Cumberland limestone than any number of scattered analyses. Prof. Lesley's attempt to ascertain a connection between a given horizon and a constant proportion of the carbonates of lime and magnesia to each other may have been suggested by some analyses which I had published previously with the same end in view (See CC, p. 307), in 1875.

The analyses made by myself are as follows:

No. 1. From the west branch of Creitz's creek, near Wrightsville.

No. 2. Upper bench ot Pine Grove quarry.

No. 3. Lower " " " "

No. 4. White limestone 100 yards east of Beeler's Cross roads, 2 miles W. by N. of York.

No. 5. Was from Detweiler's quarry, N. W. of Wrightsville.

No. 6. " " " " S. of Wrightsville.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Av.
Specific Gravity.	2.832	2.735	2.731	2.750	2.737	2.770	2.759
Insoluble Siliceous residue.	4.400	12.270	12.000	3.570	0.490	41.710	6.546
Alumina and Ferric oxide.	1.170	1.540	0.450	0.210	1.440	6.350	0.962
Carbonate of Lime ..	49.920	75.320	81.617	91.580	91.400	43.728	72.260
" of Magnesia.....	42.980	10.750	6.400	4.110	7.290	6.450	12.996
Sulphur.....	0.220	0.120	0.422	0.113	0.003	1.480	0.175
Sum.....	98.690	100.000	100.489	99.583	100.623	99.718	99.850

Note 5. Mr. A. S. McCreath's analysis of the coal referred to is as follows:

	P. C.
Volatile Organic Matter.....	18.482
Water.....	4.310
Fixed Carbon (by loss)	74.358
Sulphur	0.528
Ash	2.322
Sum.....	100.000

Rating this coal according to the system proposed by me in a paper in the Trans. Am. Inst. of Min. Eng. and subsequently published as part ot report MM, the p. c. Carbon is to the p. c. Volatile Hydro-Carbon : : 80.1 : 19.9 and the "Fuel Ratio" would be 4 or within the range proposed for the bituminous coals : (5 to 0).

* No. 6 not counted in the average.

Note 6. The following is an analysis by Dr. Genth of the Trap (Dolerite) dyke, which crosses Beeler's farm two miles S. W. of York.

	P. C.
Silicic oxide	52.53
Phosphoric oxide	0.15
Titanic oxide	0.32
Alumina	14.35
Ferric oxide	5.93
Ferrous oxide	5.45
Manganous oxide	(trace)
Magnesia	7.99
Lime	10.27
Lithia	(faintest trace)
Soda	1.87
Potash	0.92
Copper	(trace)
Sulphur	0.08
Ignition	1.23
	101.04

By a mineralogical analysis of the results (C, p. 123 &) it appears that there are two molecules of labradorite and one of pyroxene which together essentially make up this rock.

Note 7. In a volume entitled "The Azoic system and its proposed subdivisons," by J. D. Whitney and M. E. Wadsworth, printed as a Bulletin of the Museum of Comparative Zoology at Harvard College in August, 1884, but which might well serve as a type of all that a scientific memoir ought not to be, the authors are pleased to dispose of the work on the Archæan rocks of this State as if it were entirely due to four persons representing all grades of experience, and various dates of activity from 1858 to 1880. The two elder and better known of the four are waved aside ostensibly because they are unreliable, in that they have modified their views, or did not feel justified in drawing sharp divisions on the map which were supported only by a high degree of probability. The younger and less generally known of these, though nowhere claiming to have solved the problem of sequence, are given a prominence which contrasts strangely with their own modest words. The mystery is, however, explained when we observe that the views of Prof. Rogers and Dr. Hunt do not accord with those of the authors of the volume, whereas Mr. Charles E. Hall leans towards the view that the mica schists of the Philadelphia group, the South Valley Hill rocks, &c., are well within, if not high up in the Palæozoic column; and Prof. Prime's merit in the eyes of these authors appears to be that he has differed with Dr. Hunt as to the age of the rocks in a certain mine in Berks county. The

many sections across the crystalline rocks of the South mountain and the hills and plains of Adams, York, Lancaster and Chester counties, with the evidence they contain of the pre-Palæozoic age of these rocks, which were published in Vols. C, CC and CCC, and the part of C_4 which Prof. Lesley has permitted to appear as it was written, are easier to ignore than to invalidate. It is not necessary to characterize the conduct of authors who, professing to discuss a subject in the interest of truth, and filling pages of their books, as well as parts of their index, with unjust imputations on the truthfulness and reliability of a geologist whose services to his science are recognized throughout the world, give an example of their own possession of this virtue by suppressing all that does not happen to coincide with their own peculiar views, but which (to compensate for this) forms by far the larger part of the literature on the subject. Profs. Whitney and Wadsworth quote Mr. C. E. Hall's paper in the Am. Phil. Soc.'s Proc. of 1880, but do not allude to the criticism of those views in the A. P. S.'s Proc. for Dec., 1882, nor even quote their author's summary of his maturer views printed in part of C_4. In the criticism of the views expressed in C_6 (which are virtually the same as those read before the A. P. S. and quoted at length) the author was supported at the time by Prof. Lesley (see "The Horizon of the South Valley Hill rocks in Pennsylvania"), and the structure on which he based his argument had received the endorsement of Profs. Gosselet and Barrois on the assumption of the facts of dip, &c., about which there was no dispute. The section at "Gulf Mills," on which Mr. Hall relied (C_6, p. 32) for his structure, is shown in the above paper, where it is independently given, to have been so drawn by Mr. Hall that every synclinal is in reality an anticlinal and vice versa, and this is confirmed by a later section published in the transactions of the A. A. A. S. of the Philadelphia meeting in 1884. Further information on this subject may be found in the "Théses presentées à la Faculté des Sciences de Lille," "Reply to a paper entitled Notes on the Geology of Chester county and vicinity" (Journal of the Franklin Institute, April, 1884) and "Review of C_4" (American Naturalist, October, 1883), by the writer.

Those who would discuss the Archæan of Southeastern Pennsylvania without reference to the lessons to be learned from the South mountain in Franklin, Cumberland, Adams and York counties, or the great flat Tocquan anticlinal of Southwestern Lancaster are incompetent to do so either from ignorance of the facts or from a disingenuous desire to suppress them.

THE BEOTHUK INDIANS.

By Albert S. Gatschet.

Second Article.

(*Read before the American Philosophical Society, May 7, 1886.*)

ROBINSON'S VOCABULARIES.

Since the publication of the first article on the Beothuk Indians (Proc. Amer. Philos. Soc'y, 1885, pp. 408–424), I was so fortunate as to obtain two further vocabularies of their language, which yielded a number of terms not contained in the collections previously used. Both were written down by Capt. Hercules Robinson, of the vessel "The Favorite."

One of these is contained in *R. M. Martin's* History of Nova Scotia, Cape Breton, etc., London, Whittaker & Co., 1837. 16mo (364 pages); a book which forms volume sixth of the same author's: "The British Colonial Library, etc.," published by Bohn in 16mo. Mr. Martin extracted this vocabulary of ninety words, which stands on pp. 299–301, from the journal of Captain Robinson, and to Mr. Martin the original, from which he copied, had been loaned by the "late Secretary to the Royal Geographical Society;" cf. pp. 238,269. In Martin's text, Robinson states "that he gathered a vocabulary of Beothuk from Mary March after her capture in 1818," and that in his "paper" he inserted only "the most prominent words collected from her." In this statement are contained at least two falsehoods. Mary March was not captured in 1818, but in 1819, and Leigh's and Robinson's printed vocabularies are either copied from a common source, or Robinson, who never saw Mary March, copied from Leigh, which is more probable. The ending *-ue* (in one numeral and elsewhere) is incorrect, Leigh showing the correct form in *-uc, -uk;* cf. *nine, wind, rain, body.* An incorrect form is also contained in Robinson's terms for *eye, watch, teeth* (there is no *f* in Beothuk) and perhaps in *arrow.* But he may be more correct than Leigh in terms like *chin, iron, tickle, shoulders,* although both are rivalizing in their lack of philologic accuracy. Many terms of this list agree with those in my alphabetic list previously published, and in that case have been omitted. Whenever they agree with the first, but not with the second or third in order of the terms in the previous list, they were omitted also. Enumerated in the alphabetic order of the Beothuk terms in my previous list, the excluded words are as follows: *cat, feathers, leg, singing, to bite, to lie down, duck, man, egg, oil, knee, to sleep, mouth, eyebrow, tongue, arms, wolf, elbow, ear, ice, nails, I thank you, to swim, salmon, to kiss, husband.* At present, no trace can be found of Captain Robinson's manuscript in the library of the Royal Geographical Society, as I have been informed by its courteous secretary, Mr. Clements R. Markham. Concerning the list of terms Mr. Markham writes substantially as follows: "From 1830 to 1836

the Secretary of the R. G. S. was Capt. A. Maconochie of the Navy, when he emigrated to Tasmania (died there, 1861). He took an interest in philology and I think the vocabulary of Beothuk must have belonged to him personally, and not to the Society."

The other vocabulary of Capt. Robinson I have obtained through the kindness of Mr. James P. Howley. Having ascertained that there was in the library of the British Museum a pamphlet entitled, "A History of Mary March (Waunathoake), together with a vocabulary of the Boethuck Language," Mr. Howley had it carefully copied by one of his brothers, then stopping in the British metropolis. The description of Mary March etc., contained in it is from memory, for the paper winds up as follows: "I have written these notes from the recollection of conversations with Mr. Leigh, at Harbor Grace, several weeks ago, and I regret that I neglected to note them before many interesting particulars had escaped my memory. Hercules Robinson, H. M. Ship "Favorite;" at sea, November 7th, 1820." The Captain remarks, that the woman showed a remarkable aptitude to obtain a knowledge of English, and her powers of mimicry were so acute she either understood or conveyed her meaning by signs when language failed her, with great calmness. To conclude from this that Robinson saw Mary March himself, would be entirely wrong, for the date of November 7, 1820, does not agree with that of her presence at St. John's; nor is the vocabulary in the pamphlet anything else but a hasty copy of Leigh's collection, with a few additional words obtained from that clergyman. Its 133 terms are reproduced in full below; wherever there are two terms, the one copied from the Robinson pamphlet in London stands second in order.

Whether Capt. Robinson has copied the same vocabulary which Whiteway, the pilot of St. John's, Newfoundland, afterwards loaned to Rev. Lloyd (see Lloyd's first article, p. 23) or another, the chief merit of his two printed collections is that of confirming the fact, that Leigh's vocabulary was really obtained from Mary March, for Robinson's paper is dated three years before Nancy was brought to St. John's.

ROBINSON'S VOCABULARIES COMBINED.

abidemasheek *bake-apple;* the Newfoundland name of a wild fruit.
abidish *martin-cat, marten.*
abodoesic *four.*
abodonee *bonnet.*
abusthibit *to kneel.*
adadiminte *spoon.*
adasic *two.*
adiab *wood.*
adothe *boat, vessel.*
agamot *buttons; money.*
amamoose *woman.*
aparita bedesook *sunken seal* (probably: aparit abedesook).
awoodet *singing.*
abkashamesh *boy.*
barodiisick *thunder.*
bathue; bathuc *rain.*
beatathunt *gunpowder.*
bedesook *seal.*
bedisoni; bedesoni *sword.*
begodor *heart.*
begomot; begomat *breast.*
besdic *smoke.*

bethic *necklace.*
bethiote *good night.*
bigadosic *six.*
bobbodish *pigeon.*
bobidigimidic *berries.*
bocbodza *teeth* K.
Boeothik; Beuthook *Red Indian.*
bofomet outhermayet; bogomet outhermayet *teeth.*
boodowit *duck.*
borod and wieith *lightning* (one of these words perhaps *lighting*).
budiseet *dancing.*
bukashaman *man.*
bukashamesh *boy.*
bushudite *to bite.*
coish; ooish *lip.*
corrasoob; conasoob *sorrow.*
debine *egg.*
dedoneet *saw,* subst.
dogemat; digemat *arrow.*
dronna *hair.*
ebautho; ebauthe or ebanthe *water.*
edrathu *comb.*
edree *otter.*
emamooset *girl.*
ejibiduish *silk handkerchief.*
emet *oil.*
emoethuk *dogwood;* the Newfoundland name for the mountain ash, which in Canada is called *Rowan tree* (Howley).
enano *go out.*
ethewwit *fork.*
gadgemish *rat.*
gasset *stockings.*
gathet *one* (numeral).
gawzadun *raspberries.*
geen *nose.*
gewzewook or gewzenook *mainland.*
gidgeathue *wind.*
giggarimanet *net.*
givinya *eye.*
guashavet *bear.*
gwoshuawit *puffin.*
haddabothie *body.*
hedyyan *to stoop.*
hodamishit *knee.*
hosket *full* (verb?).
hothamashet *to run.*
howmeshet *ducks and drakes.*
iedesheet; idesheet *neck* and *throat.*
ibeath, ibemite *to yawn.*
ihingyam *clothes.*
isedoweet *sleep.*
itweena *thigh;* not thumb, q. v.
izzobauth *blood.*
japathook *canoe.*
yeothodue; yeothoduc *nine.*
kaduishnite *tickle;* Howley's copy has *sickle.*
keauthut gonothin *head.*
kius *moon.*
kooret! kooset! *come hither!*
kuis *sun.*
madyna *leaves.*
mammasmeet *dog.*
mammateek *house.*
mammausheek *islands.*
mammasameet *puppies.*
mameshuadet *drawing knife.*
mamoose *whortleberries.*
mangarewius *sun.*
manovorit *blankets.*
matheothuc *to cry.*
matheuis *hammer.*
memasuck *tongue.*
memayet *arms.*
memet *hand.*
methic *dirt.*
moidewsee *cold* (for *comb?* cf. moidensu).
moisamadrook *wolf.*
momezemethon *shoulders.*
moocus *elbow.*
moosin *shoes.*
mooshaman *ear.*
mooweed *trousers.*
mowazeenite; mouarzeenite *iron.*
mudyrat *hiccough.*
mushabauth *oakum.*
nethabeat *cattle.*

nijik ; nijick *five.*
odeiisook *goose.*
odisuit *to cut.*
odosook *seven.*
odolt *eat.*
odoosook *eight.*
oothook *tinker.*
osuk ; osuck *wife.*
osweet *deer.*
ozeru *ice.*
peatha *fur.*
pigathu *scab.*
poodybeat *oar.*
pooeth *thumb.*
possont *back.*
quish ; guish *nails.*
ruis ; kius *watch.*
shamye *currants.*
shebathoont *trap.*
shebohoweet *woodpecker.*
shedsic *three.*
shegamet *to blow the nose.*
toun *chin.*
theant *ten.*
thingaya *hatchet.*
thoowidgee *swimming.*
traunasoo *spruce.*
uine *knife.*
uvin *hop.*
wasemook *salmon.*
washewiush *moon.*
woodrat *fire.*
woothyat ; woothyot *to walk.*
zosueet *ptarmigan* (Lagopus albus); in Newfoundland called *partridge.*

ADDITIONAL HISTORIC REMARKS.

Before entering upon the discussion concerning the Beothuk language, I add a few historic remarks which have suggested themselves since completing the first article.

The tradition is generally credited, that Conception Bay received its name from *Cortereal*, and that therefore that navigator must have visited the Newfoundland coast. Whitbourne annually visited the island from about 1580 and wrote a book: "The Discovery of the Newfoundlande" in 1622.

The Baron *de la Hontan*, who in his younger years had been Lord Lieutenant of the French colony at Placentia in Newfoundland, does not mention the name of the Beothuks in his "Voyages." About 1690 he wrote: "The Eskimaux cross over to the Island of Newfound Land every day, at the Streight of Belle Isle; but they never come so far as Placentia, for fear of meeting with other savages there" (I, 210; Engl. translat. of 1735). "There are no settled savages in the Island of Newfound Land" (I, 226). He had seen Eskimos previously on Lower St. Lawrence River, northern shore. The Jesuit author *Charlevoix* states (1721) that no other Indians but Eskimos have ever been seen upon Newfoundland (Journal, Letter xi). From this it follows, that the Beothuks must have confined themselves at that time to tracts distant from white settlements, unless the French would have heard of them.

The archæologic research after Boethuk dwellings, implements, skeletons and other remains has been diligently prosecuted ever since Cormack's expeditions. Relics have been found even on Funk's Island, about thirty miles north-east of the nearest point upon the mainland, and their usual wintering place seems to have been the Exploits River. The most com-

prehensive sketch of all the explorations is contained in Lloyd's articles. Newfoundland has a population of about 120,000, which is exclusively settled upon the sea-shore. The Hudson's Bay Company uses all its influence to prevent the settling of the fertile lands in the interior of the vast island, for this would reduce the abundance of game and fur-animals in those parts, which are the stock in trade of that monopoly. The same exclusive policy* is pursued by that Company in the wide territories west and northwest of Lake Superior, and with such success, that the Riel rebellion, or so-called "half-breed war" of 1885 was the immediate outcome of it. The existence of agricultural settlements in the interior of Newfoundland would greatly facilitate and promote all researches concerning the relics of the mysterious aborigines who are now occupying our attention.

For several reasons it is surmised that Mr. W. E. Cormack took from Shanandithit a much more extensive list of vocables than the one I have obtained through Mr. Howley, which contains only the Beothuk numerals, month-names and terms corresponding to English words with initial *A* and *B*. Researches made in England and on Newfoundland failed to reveal any trace of an ampler collection. From Rennie, a half-brother of Cormack still living at St. John's, Mr. Howley gathered the following information: Cormack was educated in Edinburgh under the auspices of the late Prof. Jamieson, resided in Newfoundland till 1829, afterwards carried on a mercantile business in Victoria, Vancouver's Island as the partner of Mr. Nuttall, and died there single, about 1875 or 1877. Mrs. Scott, his sister, died in England in 1884 at a very advanced age. The late Judge Des Barres of St. John's was vice-president of the *Boeothik Institute* previously referred to, and in Cormack's time took great interest in all his efforts to acquire information on the Red Indians. That Cormack sent his vocabulary, relics and some drawings to a Dr. Yates in England, is stated by himself in his *"Notes;"* nothing else is known concerning his papers and effects.

The original of Mary March's vocabulary, taken down by Rev. Leigh, printed with many copyist's errors and since recopied by Mr. Howley, is now in possession of Rev. William Pilot. The final *k* in the printed copies is a *t* in most of the verbs in the manuscript.

Concerning the localities on Newfoundland which were the principal haunts of the Micmac Indians, Ph. Tocque, Newfoundland (pg. 506), has the following: The Micmacs have wigwams similar to those of the Red Indians. Several families were in Clode Sound, at the head of Bonavista Bay (48° 30′, eastern coast); the last family there was lost in 1841. North of that, others were at Notre Dame Bay; 60 persons belonging to the Micmacs resided at Bay Despair and in the various parts of Fortune

*The mercantile principles followed by the Hudson's Bay Company have remained the same throughout its historic existence and may be studied from the pages of Arthur Dobbs' "Account of the countries adjoining to Hudson's Bay," London, 1744.

Bay, in the south of the island. On his expedition, Mr. Cormack saw Micmac Indians in the south-west between King George the Fourth's Pond and St. George's Bay. Although the Micmacs resided chiefly on the west side, there were many points on which they came in hostile (or friendly?) contact with the Red Indians, whose most frequented haunts seem to have been in the east and north of the island.

ADDITIONAL NOTES BY MR. HOWLEY.

In various books about Newfoundland many misstatements were published about Shanandithit and her family. The facts are as follows: Shanandithit in 1823 took refuge with the white people, with her mother and sister, and at that time was about twenty-three years old. She learnt what she knew of English from Peyton's family, in whose house she staid at St. John's. Her sister died shortly after coming to St. John's, and her mother, who is described as *a morose old hag*, died a year or two after, about fifty years old, having never returned to her tribe. Only during the last winter of her life (1828–29), Shanandithit lived in Mr. Cormack's house. The emblems or figures drawn by her (represented in Article First) were called mythological emblems by Cormack, perhaps without sufficient reasons; Dr. Dawson regards them all as the totems of gentes.

The blue jay, whose feathers served for striking sparks, was not the *Corvus canadensis*, but *Cyanocitta cristata*, quite common on the west side of the island.

The puffin or sea parrot is the *Fratercula arctica* of Linné.

The sea pigeon is the black guillemot, *Urea grylle* [The Amer. Ornith. Union Check List of 1886, has *Cepphus grylle*, or Black Guillemot].

Blackbird. The robin, *Turdus migratorius*, is there called blackbird.

Capelan, a fish, is *Mallotus villosus*.

Ticklas is the kittiwake gull: *Rissa tridactyla*.

(*Cibo*, local name near Cape Breton, is the Micmac term: shibu *river*.)

REMARKS ON THE VOCABULARIES.

The precarious condition in which the words of the Beothuk language have come down to us, is due to several causes which have to be fully recognized before inquiries upon the language itself can be undertaken and variant readings reduced to their original forms. This confusion has had the following causes:

Indistinct handwriting has caused the uncertainty which in many words exists between *n* and *h*, *r* (cf. *fork*), *v* and *r*, *g* and *y*, *b* and *t* (cf. *trap*), *ck* and *ek*, *t* and *f* (in: botomet), between the capitals *B* and *R* (cf. *six*) and the final *-k* and *-t* in Leigh's vocabulary. Even among us, people of a low degree of education always write *n* like *u*, and the same thing was done by some copyists of the Beothuk vocabularies. Faulty copying was the immediate consequence of indistinct chirography.

The use of the Roman letters with the value they have in the English alphabet. This alphabet is wholly preposterous, even for English itself, and much more so for any foreign, especially illiterate languages. If the authors had been more accurate in their transcription of the words received, they would not have used *ch* sometimes for *χ*, at other times for *tch*; cf. the numerals 2, 12.

Instances where the authors failed *to hear* sounds with sufficient accuracy; cf. *cattle* (p. 421).

Insufficiency of the knowledge of English on the side of the two female informants; cf. the mistaking of *wet* for *white*. It appears that several terms were obtained not by putting questions, but by making gestures; in many vocabularies of other languages this has become a fruitful source of errors. Compare the term obtained for *islands* with that for *ship, vessel* (mamashee), and *mouth* with *tongue*.

The want of distinction between the noun and verb in English often causes grammatic confusion, as in the case of *lead, sleep, scratch*, etc. Moreover, the verb is sometimes placed in the participle, sometimes in the infinitive, especially in Rev. Leigh's vocabulary.

A few other remarks referring to the present condition of the vocabularies are as follows:

In several terms the initial sound has been dropped, either through inaccurate hearing or incompetency of the copyists: osweet for kosweet *deer*, ewis for kewis *watch*. cf. also obosheen with boobasha, oosuck with woas-sut, eesheet with mamesheet.

Instances of contraction by synizesis, ellipsis, etc., are not unfrequent: a'shoging from ashwoging *arrow;* bedoret from bogodoret *heart;* shucodimit from shucododimet "Indian cup."

The month-names were obtained by Cormack and are partly misspelt and faulty. It is very doubtful to me that April, June and September were all called by the same term, the two final syllables of which contain the word yaseek *one*, perhaps signifying *one* and *first*. But in American languages two *successive* Indian moons are often observed to possess the same name, as we see it done here in the case of October and November, whose names coincide pretty closely.

GRAMMATIC ELEMENTS.

Phonetics.

The points deducible with some degree of certainty from the very imperfect material on hand may be summed up as follows, the sounds being represented in my own scientific alphabet, in which all vowels have the European continental value:

Vowels: a ā
e ă o
i ī u ū

Diphthongs: ai, ei in by-yesh *birch*, madyrut *hiccough;* oi in moisamadrook *wolf;* ou, au in ge-oun *chin;* oe may indicate ö: emoethook (?), etc.

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Consonants:

	Explosives:		*Sounds of duration:*			
	surd	*sonant*	*Aspirates*	*Spirants*	*Nasals*	*Trills*
Gutturals:	k	g	χ	h	ng	
Palatals:	tch	dsh		y		°l
Linguals:				sh		r, l
Dentals:	t	d	th	s, z	n	
Labials:	p	b		w, (v?)	m	

The sound expressed by lth in adolthtek, adolthe *boat* I have rendered by °l, the palatalized l, which is produced by holding the tip of the tongue against the alveolar or foremost part of the palate. It appears in many American, but not in Algonkin languages.

The sound dr, tr in adamadret, adamatret *gun*, drona *hair*, edrú *otter* and other terms is probably a peculiar sound, and not a mere combination of d(t) with r.

The articulation dth seems distinct from the aspirate th of the English language; it occurs in dthoonanyen *hatchet*, dthō-ōnut *ten*, used in forming the decade in the terms for twenty, thirty, etc. (cf. theant and shansee *ten*). Perhaps it is *th* pronounced with an explosive effort of the vocal organ.

χ is rendered in our lists by *gh* and sometimes by *ch*, as in yaseech *one*, drone-ooch *hairs*, máduch *to-morrow*.

ts, *ds* are unfrequent or do not occur at all.

sch in deschudodoick *to blow* and other terms is probably our sk.

f does not occur in Beothuk, but is found in Micmac vocabularies; perhaps it would be better to have rendered there that sound by v'h, w'h and not by *f*, for other Algonkin dialects show no trace of it.

l is unfrequent and found, as an initial sound, only in the term lathun *trap*. Whether *r* is our rolling *r* or not is difficult to determine.

th often figures as a terminal, but more frequently as an initial and medial sound.

Consonants are frequently found geminated in our lists, but this is chiefly due to the graphic method of English writers, who habitually geminate them to show that the preceding vowel is short in quantity: cf. dattomeish, haddabothic, immamooset, massooch.

The language exhibits the peculiarity not unfrequently observed throughout America, that final syllables generally end in consonants and the preceding syllables in vowels. Accumulations of consonants occur, but are not frequent; e. g. carmtack *to speak*, Mamjaesdoo, nom. pr. The majority of all syllables not final consists of a consonant followed by a vowel, or diphthong.

Too little information is on hand to establish any general rules for the *accentuation*. None of the accented words are oxytonized, but several have the antepenult emphasized: báshedtheek, áshwoging, dósomite; the term éjabathook has the accent still further removed from the final

syllable. Very likely the accent could in that language shift, as in other languages of America, from syllable to syllable, whenever *rhetorical* reasons required it. By some of the collectors the signs for length and brevity were used to designate the emphasized syllable, placed above or underneath the vowels.

Alternation of sounds, or spontaneous permutation of the guttural, labial, etc., sounds without any apparent cause, is traceable here as well as in all other illiterate languages. Thus the consonantic sounds produced in the same position of the vocal organs are observed to alternate between:

g and k: buggishaman, bukashaman *man*, etc.
g and χ: bogomot, boghmoot *breast*.
g and h: buggishamesh, buhashamesh *boy;* bogathoowytch *to kill*, buhashauwite *to beat*.
tch and sh: mootchiman, mooshaman *ear*.
dsh and s, sh: wadshoodet, washoodiet *to shoot*.
r and d: merobeesh, madabeesh *thread, twine*.
t and d: tapathook, dapathook *canoe*.
t and th: meotick, mae-adthike *house;* mattic, mathick *stinking*.
d and th: ebanthoo, ebadoe *water*.
th and z: nunyetheek, ninezeek *five*.
th and s, sh: mamud-thuk, memasook *tongue;* thámook, shamook *capelan*.
s and z: osenyet, ozegeen *scissors*.
s and sh: māmset, mamishet *alive;* bobboosoret, baubooshrat *codfish*.
p and b: shapoth, shaboth *candle*.

In regard to vowels, the inaccurate transmission of the words does not give us any firm hold; still we find alternation between:
a and o: bogomat, bogomot *breast;* dattomeish, dottomeish *trout*.
a and e: baasick, bethec *beads*.
oi and ei: boyish, by-yeech *birch*.

Morphology.

The points to be gained for the morphology of Beothuk are more scanty still than what can be obtained for reconstructing its phonology, and for the inflection of its verb we are entirely in the dark.

Substantive. The most frequent endings of substantives are *-k* and *-t*, and a few only, like drona *hair*, end in a vowel. Whether the substantive had any inflection for case or not, is not easy to determine; we find however, that maemed *hand* is given for the subjective, meeman (in m. monasthus *to shake hands*) for the objective case; in the same manner nechwa and neechon *tobacco*, mameshook and mamudthun *mouth*. Other terms in *-n* are probably worded in the objective or some other of the oblique cases: ewinon *feather*, magorun *deer's horns*, mooshaman *ear*, ozegeen *scissors*, shedothun *sugar*. Cf. the two forms for *head*.

A plural is traceable in the substantives deyn-yad *bird*, deyn-yadrook *birds;* odizeet, pl. odensook *goose*, drona, pl. drone-ooch *hair;* and to judge

from analogy, the following terms may possibly be worded in the plural form: marmeuk *eyebrow(s)*, messiliget-hook *bab(ics?)*, moisamadrook *wol(ves?)*, berroich *clouds*, ejabathook *sails*. Compare also edot *fishing line*, adothook *fish hook;* the latter perhaps a plural of the former. The numerals 7, 8, 9 also show a suffix -uk, -ook.

Adjectives are exhibiting formative suffixes of very different kinds gosset and gausep *dead*, gasook *dry*, boos-seek *blunt*, homedich *good*, ass-soyt *angry*, eeshang-eyghth *blue*, ashei *lean*.

The phrase shedbasing wáthik *upper arm* would seem to show, that the adjective, when used attributively, precedes the noun which it qualifies.

The numerals of our list are all provided with the suffix -eek or -ook; what remains in the numerals from *one* to *ten*, is a monosyllable, except in the instance of *six* and *nine*. Yaseek is given as *one* and as *first* (in the term for *April*),* but whether there was a series of real ordinals we do not know.

Compound nouns. A few terms are recognizable as compound nouns, and in them the determinative precedes the noun qualified:

wash-geuis *moon*, lit.: "night-sun."
bobbiduish-emet *lamp;* probably: "fire-oil."
kaesin-guinyeet *blind;* probably for "dry on eyes."
moosin-dgej-jebursūt *ankle;* contains mōosin *moccasin*.
adasweet-eeshamut *December;* contains odusweet *hare, rabbit*.
aguathoonet *grinding stone;* probably contains ahune *stone* in the initial agu-, agua-.

No *pronouns* whatever could be made out with any degree of probability.

Concerning the *verbal inflection* we are almost entirely without reliable dates, nor do we know anything concerning the subjective and objective pronouns necessarily connected with conjugational forms.

(1.) Verbs mentioned in the participle *-ing* or in the infinitive generally end in -t and -k.

-t: ámshut *to get up*, awoodet *singing*, bituwait *to lie down*, cheashit *to groan*, mārot *to smell*, kingiabit *to stand*, washoodiet *to shoot*.

-k: carmtack *to speak*, deschudodoick *to blow*, ebathook *to drink*, odishuik *to cut*.

(2.) Imperative forms, to judge from the English translation, are the following:

deiood! *come with us!* dyoom! *come hither!*
dyoot thouret! *come hither!* (Rob. kooret! kooset!)
nadyed *you come back* (?)
cockabóset! *no fear! do not be afraid!*
bobáthoowytch! *beat him!*
deh-hemin! *give me!*

(3.) Participial forms are probably represented by: amet *awake*, gosset and gausep *dead*, apparet *sunken* (Rob. aparit.)

* Perhaps also in *June, July, September*.

(4.) The first person of the singular is, according to the interpretation, contained in the vocables:
ajeedick or vieedisk *I like.*
boochauwit *I am hungry*, cf. dauosett.
a-oseedwit *I am sleepy*, cf. bootzhawet *sleep*, isedowweet *to sleep.*
thine *I thank you.* Cf. what was said of betheoate.*

(5.) Other personal forms of singular or plural are probably embodied in the terms:
pokoodoont, from odoit *to eat.*
ieroothack, jeroothack *speak*, from carmtack *to speak.*
becket? *where do you go?*
boobasha, cf. obosheen *warming yourself.*

(6.) Forms in -p and -ss, if not misspelt, occur in: âthep, athess *to sit down*, gamyess *get up*, gausep *dead.*

(7.) No conclusive instance of reduplication as a means of inflection or derivation occurs in any of the terms transmitted, though we may compare wawashemet, p. 423, Nonosabasut, nom. pr. Is mammateek a reduplication of meotick?

Derivation.

Derivatives and the mode of derivation are easier to trace in this insular language than other grammatic processes. Although the existence of prefixes is not certain as yet, derivation through suffixes can be proved by many instances, and there was probably a large number of suffixes, simple and compound, in existence. Some of the suffixes were mentioned above, and what may be considered as "prefixes (?)" will be treated of separately.

Suffix *-eesh; -eech, -ish* forms diminutive nouns:
mammusemitch *puppy*, from mamasameet *dog.*
mossessdeesh *Indian boy.*
buhashamesh *boy*, from bukashaman *man.*
woaseesh *Indian girl*, from woas-sut *Indian woman.*
shuwänyish *small vessel*, from shuwän *bucket, cup.*
mandeweech *bushes* (?); hanyees *finger.*
Probably the term yeech *short* is only deduced from the above instances of diminutives, and had no separate existence for itself.

-eet, a frequently occurring nominal suffix:
a-eshemeet *lumpfish*, deddoweet *saw*, gaboweete *breath*, kosweet *deer*, kusebeet *louse*, methabeet *cattle*, shebohoweet *woodpecker*, sheedeneesheet *cocklebur*, sosheet *bat*, tedesheet *neck*, wobesheet *sleeve*, probably from wobee *white.* Also occurring as a verbal ending, cf. above; hence, it is possible that the nouns in -eet are simply *nomina verbalia* of verbs in -eet, -ît.

*The Algonkin na-, nu-, n- of the first person occurs in none of these examples.

-k, a suffix found in verbs and nouns:
ebanthook *to drink*, from ebanthoo *water*.
obesedeek *gloves*, perhaps (if not *plural* form) from obosheen, q. v.
Verbs in -k were mentioned *supra*; -ook forms plurals of substantives, also numerals; in Micmac the suffix for the plural of animates is -ûk, -k, for inanimates -ûl, -l; in Abnáki-ak, -al.

-m occurs in nouns like dingyam *clothes*, lathum (?) *trap*, woodum *pond*; also in ibadinnam, jewmetchem, etc.

-n, suffix of objective case and of many substantives.

-oret, nominal suffix in bobboosoret *codfish*, bogodoret *heart*, manaboret *blanket*, oodrat *fire*, shawatharott *man*.

-uit, *-wit* occurs in kadimishuite *tickle*, ethenwit *fork*, mondicuet *lamp*, Demasduit, nom. pr., guashuwit *bear*; also in sundry verbs.

-ut occurs in nouns:
woas-sut *Indian woman*, mokothut *fish-species*, madyrut *hiccough*.

Prefixed Parts of Speech.

Follows a series of terms or parts of speech, found only *at the beginning* of certain words. Whether they are particles of an adverbial or prepositional nature (prefixes), or fragments of nouns, was not possible for me to decide. The dissyllabic nature of some of them seems to favor a nominal origin.

bogo-, *buka-*: bogodoret, abbr. bĕdoret *heart*.
bogomat *breast*.
bogathoowytch *to kill, beat*.
bukashaman *man*.
buggishamesh *boy*.
shema bogosthuc *moskito*.

ee- is the prefix of numerals in the decad from 11 to 19.

hada-, *ada-*, *hoda-*, *odo-*, *od-* is found in terms for tools, implements, parts of the animal body; *a* is easily confounded with *o* by English-speaking people.
haddabothic *body*, hadabatheek *belly*
hodamishit *knee*, cf. hothamashet *to run*.
hadalahet *glass* and *glass-vase*.
hadowadet *shovel*, cf. od-ishuik *to cut*, and godawik.
adamadret *gun, rifle*.
adadimite *spoon*.
ardobeesh *twine*; is also spelt adobeesh (Howley).
adothook *fishhook*.
adoltkhtek, odo-ōthyke *boat, vessel*.

mama-, *mema-*. The terms commencing with this group are all arrayed in alphabetic order on pp. 420, 421, and point to living organisms or parts of such or dwellings.

Remarks on Single Terms.

For several English terms the English-Beothuk vocabulary gives more than one equivalent, even when only one is expected. With some of their number the inference is, that one of these is Beothuk, while the other is borrowed from an alien language. Thus we have :

devil ashmudyim, haoot.
comb edrathu, moidensu.
hammer iwish, mattuis.
money agamet, beodet. The fact that agamet also means *button* finds a parallel in the Creek language, where the term for *bead*, χo'nawa, χo'nap, forms also the one for *coined money :* tchátu χo'nawa, "*stone bead*" or "*metal bead.*"
bread annawhadya, manjebathook.
lamp bobbiduish-emet, mondicuet.
star adenishit, shawwayet.
grinding stone aguathoonet, shewthake.
shovel godawik, hadowadet.
trap lathun, shabathoobet.

See also the different terms for *cup* (vessel), *spear, wife, feather, boy, rain, to hear*, etc. Concerning the term *trap*, one of the terms may be the noun, the other the verb (*to trap*). Terms traceable to alien languages will be considered below.

The term for *cat* is evidently the same with that for *seal* and *marten*, the similarity of their heads being suggestive for name-giving. In the term for *cat*, abideshook, a prefix *a-* appears, for which I find no second instance in the lists; abidish is, I think, the full form of the singular for all the three animals.

Of the two terms for *fire*, boobeshawt means *what is warming*, cf. boobasha *warm*, and oodrat is the proper term for fire.

Smoke and *gunpowder* are expressed by the same word in many Indian languages; here, the one for *gunpowder*, baasothnut, is a derivative of basdic *smoke*.

The *muskito*, shema bogosthuc, is described as a black fly.

Whadicheme in King's vocabulary means *to kill.*

Beothik as name for *man, Indian* and *Red Indian* is probably more correct than the commonly used Beothuk.

botomet onthermayet probably contains a whole sentence.

The term for *hill*, keoosock, kaasook is probably identical with keathut *head.*

Eeshamut appears in the names for *December* and *January ;* signification unknown.

ETHNIC POSITION OF THE BEOTHUK.

The most important result to be derived from researches on the Beothuk people and language must be the solution of the problem, whether they

formed a race for themselves and spoke a language independent of any other, or are racially and linguistically linked to other nations or tribes.

Our means for studying their racial characteristics are very scanty. No accurate measurements of their bodies are on hand, a few skulls only are left as tangible remnants of their bodily existence (described by George Rusk; cf. p. 413). Their appearance, customs and manners, lodges and canoes seem to testify in favor of a race separate from the Algonkins and Eskimos around them, but are too powerless *to prove* anything. Thus we have to rely upon language alone to get a glimpse at their origin or earliest condition.

A comparison with the Labrador and Greenland *Inuit* language, commonly called Eskimo, has yielded to me no term resting on real affinity. The Greenlandish attausek *one* and B. yaseek *one* agree in the suffix only.

R. G. Latham has adduced some parallels of Beothuk with Tinné dialects, especially with Taculli, spoken in the Rocky Mountains. But he does not admit such rare parallels as proof of affinity, and in historic times at least, the Beothuks dwelt too far from the countries held by Tinné Indians to render any connection probable.

Not the least affinity is traceable between Beothuk and *Iroquois* vocables, nor does the phonology of the two yield any substantial points of equality. Tribes of the Iroquois stock once held the shores of the St. Lawrence river down to the environs of Quebec, perhaps further to the northeast and thus lived at no great distance from Newfoundland.

All that is left for us to do is to compare the sundry *Algonkin* dialects with the remnants of the Beothuk speech. Among these, the Micmac of Nova Scotia and parts of the adjoining mainland, the Abnáki of New Brunswick and Maine, the Naskápi of Labrador will more than others engross our attention, as being spoken in the nearest vicinity of Newfoundland. The first of these, Micmac, was spoken also upon the isle itself. Here as everywhere else, words growing out of the roots of the language and therefore inherent to it, have to be carefully distinguished from *terms borrowed* of other languages. It will be best to make here a distinction between Beothuk terms *undoubtedly* Algonkin in phonetics and signification and other Beothuk terms, which *resemble* some words found in Algonkin dialects. Words of these two categories form part of the list of duplex Beothuk terms for one English word, as given on a previous page.

(1) *Beothuk words also occurring* in Algonkin dialects:

-eesh, -ĭsh, suffix forming diminutive nouns; occurs in various forms in all the Eastern Algonkin dialects.

mamishet; mamseet *alive, living;* Micmac meemajeet, perhaps transposed from almajeet.

mattuis *hammer;* Abnáki mattoo.

mandee *devil;* Micmac maneetoo, Naskápi (matchi) mantuie.

odemen, odemet *ochre;* Micmac odemen.

shebon, sheebin *river;* Micmac seiboo; sibi, sipi in all Eastern Algonkin dialects for *long* river.

wobee *white;* Micm. wabaee, Naskápi waahpou, wahpoau *white;* also in all Eastern Alg. dialects. cf. B. wobesheet *sleeve,* probably for "white sleeve," and Micmac wobun *daylight.*

(2.) *Beothuk words resembling* terms of Algonkin dialects comparable to them in phonetics and signification. Some of them were extracted from R. G. Latham's comparative list, in his *Comp. Philology,* pp. 453–455.

bathuk *rain;* Micmac ikfashak, -paesuk in kiekpaesuk *rain;* but the other forms given in Beothuk, badoese and watshoosooch, do not agree. Cf. ebanthoo *water.*

boobeshawt *fire.* The radix is boob- and hence no analogy exists with Ottawa ashkote, Abnáki skoutai and other Alg. terms for *fire* mentioned by Latham.

bukashaman *white man, man.* Affinity with Micmac wabe akecheenom *white man* (jaaenan *man*) through aphaeresis of wa- is exceedingly doubtful. Compare the Beothuk prefixed syllable *bogo-.*

emet *oil;* Abnáki pemmee, Ojibwē bimide *oil;* Micmac memā' *oil, fat, grease.*

kannabuch *long;* cf. the Algonkin names Kennebec, Quinnipĭac *long (inlet),* and the Virginian cunnaivwh *long* (Strachey, p. 190).

kewis, kuis *sun, watch;* watcha-gewis *moon* (the form kius is misspelt); Micm. nakoushet *sun,* topa-nakoushet *moon* (in Naskápi beshung, beeshoon *sun* and *moon*). The ordinary term in the Eastern Alg. languages is gísis, kísûs, kíshis for both celestial bodies; goos is the Micmac *month* appended to each of their month-names.

magaraguis, magaragueis, mangaroouish *son.* Latham, supposing -guis to be the portion of the word signifying *son,* has quoted numerous analogies, as Cree equssis, Ottawa kwis, Shawano koisso, etc., but Robinson has mangarewius *sun,* King has kewis, kuis *sun, moon,* which makes the above term very doubtful. Probably it was the result of a misunderstanding; cf. magorun *deer(?),* kewis *sun.*

mamudthun *mouth.* Latham refers us to Abnáki madoon, Micmac toon, but Leigh has mameshook for *mouth* and memasook for *tongue,* which proves that mam-, mem- is the radix of the Beothuk word and not dthun.

mamoodthuk *dog,* mamoosemĭtch *puppy;* Micmac alamonch, elmooche *dog,* elmoojeek *puppies,* Abnaki almoosesauk *puppies* (alma- in Abn. corresponds to mama- in Beothuk).

manjebathook *bread* contains in its final part beothuk *man, people;* and in its first perhaps Micmac megisee, maegeechimk *to eat,* mijesé *I eat,* or the French *manger,* obtained through Micmac Indians. So the signification would be "people's food."

manus *berries;* Micmac minigechal *berries* may be compared, provided mini- is the basis of the term.

mŏosin *moccasin,* meoson *shoe;* probably originated from Abnáki (and other Algonkin): mkison *moccasin* through ellipse.

mootchiman *ear;* in Algonkin dialects táwa is *ear* and therefore Latham is mistaken in comparing Micmac mootooween, Abnaki nootawee (*my* ear).

muddy, mud'ti *bad, dirty;* could possibly be the transformed Ottawa and Massach. word matche, Mohican matchit, Odjibwē mudji *bad,* quoted by Latham. Ashmudyim *devil* is a derivative of muddy.

noduera *to hear* is probably the Micmac noodâk *I hear* (*him*).

woas-seesh *girl* is a derivative of woas-sut *woman,* and therefore affinity with the Naskâpi squashish *girl* through aphaeresis is not probable, sehquow (s'kwâ) being *woman* in that language. In the Micmac, epit is *woman,* epita-ish *girl.*

The lists which yielded the above Algonkin terms are contained in: A. Gallatin's *Synopsis,* Archæologia Americana, Vol. ii, (1836); in Collections of Massachusetts Histor. Society, I. series, for 1799, where long vocabularies of *Micmac, Mountaineer* and *Naskápi* were published; in Rev. Silas T. Rand's *First Reading Book* in the Micmac language, Halifax, 1875, 16mo; also in *Abnáki* (Benekee) and *Micmac lists* sent to me by R. G. Latham and evidently taken with respect to existing Beothuk lists, for in both are mentioned the same special terms, as *drawing knife, capelan, Indian cup, deer's horns, ticklas,* etc. W. E. Cormack or his attendants probably took all these three vocabularies during the same year.

In order to obtain a correct and unprejudiced idea of our comparative Beothuk-Algonkin lists, we have to remember that the Red Indians always kept up friendly intercourse and trade with the Naskapi or Mountaineer Indians of Labrador, and that during the *first half* of the eighteenth century, when Micmacs had settled upon Newfoundland, they were, according to a passage of Jukes' "Excursions," the friends of the Beothuk also. During that period the Beothuk could therefore adopt Algonkin terms into their language to some extent and such terms we would expect to be chiefly the words for tools, implements and merchandize, since these were the most likely to become articles of intertribal exchange. Thus we find in list No. 1 terms like *hammer* and *ochre,* in list No. 2 *bread, moccasin* and *dog.* We are informed that the Beothuk kept no dogs, and when they became acquinted with these animals, they borrowed their name from the tribe in whose possession they saw them first. The term mamoodthuk *dog* is, however, of the same root as mamishet, mamset *alive,* which we find again in Micmac,* and it is puzzling that the Beothuk should have had no word of their own for *alive.* Exactly the same remark may be applied to wobee *white* and the suffixes -eesh and -ook, all of which recur in Algonkin languages. Concerning shebon *river,* we recall the fact that the Dutch originally had a Germanic word for *river,* but exchanged it for the French *rivière;* also, that the French adopted *la crique* from the English *creek,* just as they have formed *bébé* from English *baby.* The term for *devil* could easily be borrowed from an alien people, for deity names travel from land to land as easily as do the religious ideas themselves. The majority of

* Micmac:-memaje *I live,* memajoo-ōkun *life.*

these disputed terms came from Nancy, who had more opportunity to see Micmacs in St. John's than Mary March.

In our comparative list No. 2, most of the terms do not rest upon radical affinity, but merely on apparent or imaginary resemblance. In publishing his comparative list, Mr. Latham did not at all pretend to prove by it the affinity of Beothuk to Algonkin dialects; for he distinctly states (p. 453): "that it was akin to the (languages of the) ordinary American Indians rather than to the Eskimo; further investigation showing that, of the ordinary American languages, it was Algonkin rather than aught else." In fact, no real affinity is traceable except in *dog*, *bad* and *moccasin*, and even here the unreliable orthography of the words preserved leaves the matter enveloped in uncertainty.

The suffix -eesh and the plurals in -ook are perhaps the strongest arguments that can be brought forward for Algonkin affinity of Beothuk, but compared to the overwhelming bulk of words entirely differing this cannot prove anything. In going over the Beothuk list in 1882 with a clergyman thoroughly conversant with Ojibwē, Rev. Ignatius Tomazin, then of Red Lake, Minnesota, he was unable to find any term in Ojibwē corresponding, except wobee *white*, and if gigarimanet, *net*, stood for *fishnet*, gigo was the Ojibwē term for *fish*.

The facts which most strongly militate against an assumed kinship of Beothuk with Algonkin dialects are as follows:

(1.) The phonetic system of both differs largely; Beothuk lacks f and probably v, while l is scarce; in Micmac and the majority of Algonkin dialects th, r, dr and ᶜl are wanting, but occur in Beothuk.

(2.) The objective case exists in Beothuk, but none of the Algonkin dialects has another oblique case except the locative.

(3.) The numerals differ *entirely* in both, which would not be the case if there was the *least* affinity between the two.

(4.) The terms for the parts of the human and animal body, for colors (except *white*), for animals and plants, for natural phenomena, for the celestial bodies and other objects of nature, as well as the radicals of adjectives and verbs differ completely.

When we add all this to the great discrepancy in ethnologic particulars, as canoes, dress, implements, manners and customs, we come to the conclusion that the Red Indians of Newfoundland must have been a race distinct from the races on the mainland shores surrounding them on the North and West. Their language I do not hesitate, after a long study of its precarious and unreliable remnants, to regard as belonging to a *separate linguistic family*, clearly distinct from Inuit, Tinné, Iroquois and Algonkin. Once a refugee from some part of the mainland of North America, the Beothuk tribe may have lived for centuries isolated upon Newfoundland, sustaining itself by fishing and the chase.* When we look

* Linguistic stocks reduced like Beothuk to a small compass are of the highest importance for anthropologic science. Not only do they disclose by themselves a new side of ethnic life, but they also afford a glimpse at the former distribution of tribes, nations, races and their languages and ethnographic peculiarities.

around upon the surface of the globe for parallels of linguistic families relegated to *insular homes*, we find the Elu upon the island of Ceylon in the Indian ocean, and the extinct Tasmanian upon Tasmania island, widely distant from Australia. The Harafuru or Alfuru languages of New Guinea and vicinity, are spoken upon islands only. Almost wholly confined to islands are the nationalities speaking Malayan, Aino, Celtic, Haida and Ale-ut dialects; only a narrow strip of territory now shows from which portion of the mainland they may have crossed over the main to their present abodes.

ENGLISH-BEOTHUK VOCABULARY.

afraid, to be see geswat.
alive mamishet.
angry a'ss-soyt.
ankle moosindgei-jebursūt.
April wasumaweeseek.
arm wa'thik; memayet; see also maemed, memayet Rob.
arm, upper shedbasing wathik.
arm, the whole wātheēkee.
arrow ăshwoging; dogernat; dogemat Rob.
ash see *mountain ash*.
August wadawhegh.
awake amet.
baby messiliget-hook.
back (subst.?) possont Rob.
bad muddy.
bake-apple abidemasheek Rob.
bat sosheet.
bead baasi'ck.
bear guashuwit; Rob.
beat, to see bogathŏowytch.
beaver mamshet.
belly see haddabothic.
berries bibidegemidic; manus; bobidigimidic Rob.
birch boyish.
bird deyn-yad.
bird, little obseet.
bite, to bashoodite; bushudite Rob.
black mandzey.
blackbird woodch.
blanket manaboret; Rob.
blind kaesinguinyeet.
blood ashaboo-uth; izzobauth Rob.
blow, to deschudodoick.
blow the nose, to shegamite Rob.
blue eeshang-eyghth.
blunt boos-seek.
boat adoltkhtek; adothe Rob.
boat, large dho-ōrado.
body haddabothic; Rob.
boil, to oadjameet.
bone a-enamin.
bonnet abodooneek; abodonee Rob.
bosom see bogomet.
bow anyemen.
boy būhāshămēsh; bakashamesh and bukashamesh Rob.
bread annawhadya; manjebathook.
breast bogomot.
breath gaboweete.
brook shebon.
bucket shoe-wana.
bushes mandeweech.
buttons agamet; agamot Rob.
candle sha'poth.
canoe tapathook; japathook Rob.; see also *boat*.
cap eeseeboon.
capelan shamoth.
cat, domestic abideshook.
cat; see *marten*.
cattle methabeet; nethabeat Rob.
cheek weenoun.
child emamooset.
chin ge-oun; toun Rob.
clothes dingyam; ihingyam Rob.
clouds berrooick.
cocklebur sheedeneesheet.

codfish bobboosoret.
cold eenoaja ; moidewsee Rob.
comb moidensu ; edrathu Rob.
come, to see deiood, thooret.
come back; see deiood.
come hither! kooret Rob.
comet anin.
consort anwoyding.
cream jug motheryet ; nádalahet.
cry, to matheoduc ; Rob.
cup manune.
cup, drinking shoe-wana.
currant shamye Rob.
cut, to odishuik ; Rob.
dancing badisut ; budiseet Rob.
darkness washewtch.
dead gausep.
death see gausep.
December odasweeteeshamut.
deer kōsweet ; osweet Rob.
deer's horns magorun.
deer-spear amina.
devil ashmudyim ; haoot.
dirt methic Rob.
dirty muddy.
dog mämmäsäveet ; Rob.
dogwood emoethook ; emoethuk Rob.
drake see mameshet.
drawing knife moeshwadit ; mameshuadet Rob.
drink, to ebathook.
dry gasook.
duck boodowit ; eesheet ; mameshet ; cf. boodowit and howmeshet Rob.
eagle gobidin.
ear mooshaman ; Rob.
eat, to odoit ; Rob. ; pokoodont.
egg dębine ; Rob.
eight adozook ; odoosook Rob.
elbow moocus ; Rob.
eleven see yaseek.
Eskimo Ashwan.
eye gheegnyan ; givinya Rob.
eyebrow marmeuk.
fall, to koshet ; hosket Rob.
fat eeg ; eed Howley.
fear geswat.
feather abobidress ; ewinon.
February kosthabonóng bewajowit.
fifteen see ninezeek.
finger hanyees.
fire boobeeshawt ; oödrat ; woodrat Rob.
fish baubooshrat.
fish (a species) mokothut
fishhook adothook.
fishing line edat.
five ninezeek ; nijik Rob.
flesh áshautch.
fly, to miaoth.
foot adyouth.
forehead doothun.
forest see *tree.*
fork ethenwit ; Rob.
four dábseek ; abodoesic Rob
fourteen; see dábseek.
fox dogajavick.
fur peatha Rob. ; see also geonet.
gaping abemite.
get up gamyess ; see ámshut.
get up, to ámshut.
gimlet quadranuek.
girl emamooset ; Rob.
give me! deh-hemin! *we give you a knife* see wawashemet.
glass hádalahét.
gloves obsedeek.
good homedich.
good night betheoate ; Rob.
goose odensook ; Rob.
go, to; to go out see baetha ; euano; enano Rob.
go home baetha.
go to bed, to poochauwhat.
gooseberry jiggamint.
grindstone aguathoonet ; shewthake.
groan, to cheashit.
guillemot osthuk.

gun adamadret.
gunpowder baasothnut ; beatathunt Rob.
hair drona ; Rob.
half moon see kewis.
halibut hanawāsutt.
hammer iwish ; mattuis ; matheuis Rob.
hand maemed ; memet Rob. ; see *shake hands, to.*
hare odusweet.
harlequin duck mammadronit.
hatchet dthŏŏnanyen ; thingaya Rob.
hatfish hanawāsutt.
head keathut ; Rob.
hear, to eenódsha ; noduera.
heart bogodoret ; begodor Rob.
heaven theehone.
herring weshomesh.
hiccough madyrut ; mudyrat Rob.
hill keoosock ; see keathut.
hoop woin ; uvin Rob.
horn; deer's horns magorun.
house meotick ; mammateek Rob.
hungry boochauwhit ; cf. dauosett.
husband anwoyding ; zathrook.
hut meotick.
ice ozeru ; Rob.
Indian Beothuk.
Indian boy see mozazeosh.
Indian cup shucododimet.
iron mowageenite ; Rob.
islands mammasheek ; Rob.
January kobshuneesamut.
July kowayaseek.
June wasumaweeseek.
kill, to bogathŏowytch ; datyuns ; whadicheme.
kiss, to widumite.
knee hodamishit ; Rob.
kneel, to akusthibit ; abusthibit Rob.
knife eewā-en ; uine Rob.
lamp bobbiduishemet ; mondicuet.
lead (subst.?) goosheben.
lean ashei.
leaves madyna Rob.
leg aduse.
lie down, to bituwait.
life see mamishet.
lightning borod *and* wieith Rob.
like, I ajeedick.
lip ooish ; coish, ooish Rob.
lobster odjet.
long kannabuch.
lord bird mammadronit.
louse kusebeet.
lumpfish a-eshemeet.
mainland gungewook ; gewzewook Rob.
make haste eeshoo.
man bukashaman ; Rob.
March manamiss.
marten abidish ; Rob.
Mary March Demasduit ; Waunathoake.
May bedejamish bewajowite.
meat áshautch.
Micmac Indian Shanung.
milk madabooch.
moccasin mŏosin.
money agamet; agamot Rob. ; beodet
moon kewis ; washa-geuis ; kius and washewiush Rob.
moskito shema bogosthuc ; see *nipper.*
mountain ash emoethook.
mouth mameshook.
mythologic symbols ; see ashwameet, kewis, owasboshno-un.
nails quish, Rob.
Nancy Shanandithit.
Naskapi Indians Shō-udamunk.
neck tedesheet ; iedesheet Rob.
necklace zeek ; bethic Rob ; see baasi'ck.
net gigarimanet ; Rob.
night washewtch.
nine yéothoduc ; Rob.
nineteen see yéothoduc.
nipper (moskito) bebadrook.
no newin.

nose gheen ; geen Rob.
November godabonyeesh.
oakum mushabauth Rob.
oar podibeak ; poodybeat Rob.
ochre odemen.
October godabonyegh.
oil emet ; Rob.
one yaseek ; gathet Rob.
otter edrú ; edree Rob.
outdoors see baetha.
paddle podibeak ; poodybeat Rob. ; see *to row*.
partridge zósoot.
pigeon bobbidist ; Rob.
pin dósŏmite.
pitcher manune.
pond woodum.
ptarmigan zosueet Rob. ; see zósoot.
puffin guashawit ; Rob.
puppy see māmmăsăveet ; mammasameet Rob.
rain bathuc ; watshoosooch ; bathue Rob.
raspberries gawzadun Rob.
rat gadgemish Rob.
red deed-rashow.
Red Indian (man) Beothuk ; Shawatharott ; Boeothik Rob.
Red Indian boy mozazeosh.
Red Indian girl woas-eeash.
Red Indian woman woas-sut.
rifle adamadret.
river shebon.
rock ahune
row, to osavate ; see *oar*.
Rowan tree see dogwood.
run, to ibadinnam ; wothamashet ; hothamashet Rob.
sail éjabathook.
salmon wāsemook ; Rob.
salt water mássooch.
saw (subst.) deddoweet ; dedoneet Rob.
scab pigathu Rob.
scissors oseenyet.
scollop gowet.
scratch bashubet.
sea-gull asson.
seal bidesook ; see mathik. bedesook Rob.
seal-spear a-aduth.
seal, sunken apparet o bidesook ; Rob.
see, to ejew.
September wasumaweeseek.
seven o-odosook ; odosook Rob.
seventeen see o-odosook
shake hands kawingjemeesh ; meeman monasthus, see maemed *hand*.
ship mamashee ; adoltkhtek ; see *canoe*.
shoe see mōosin ; Rob.
shoot, to washoodiet.
short yeech.
shoulder manegemethon ; momezemethon Rob.
shovel godawik ; hadowadet.
sick ashei.
sickle see kaduishnite Rob.
silk handkerchief egibididuish ; ejibiduish Rob.
sinew (of deer) modthamook.
singing awoodet ; Rob.
sit down, to athess.
six bāshedtheek ; bigadosic Rob.
sixteen see bāshedtheek.
sleep, to bootzhawet ; isedoweet.
sleepy, I am a-oseedwit.
sleeve wobesheet.
smell, to mārot.
smoke basdic ; besdic Rob.
snail ae-u-eece.
sneeze, to adjith.
snipe aoujet.
snow kaasussabook.
son magaraguis ; see mangaroonish.
soon jewmetchem.
sore throat anadrik.
sorrow corrasoob ; conasoob Rob.
speak, to carmtack.
spear ánun.
spider woadthoowin.

spoon adadimite ; Rob.
spruce traunasoo Rob.
stand, to kingiabit.
star adenishit, shawwayet.
stinking mathik.
stockings see gasook ; gasset Rob.
stone see *rock*.
stoop, to hedyyan Rob.
sugar shedothun.
sun kewis (see mangaroonish); kuis and mangarewius Rob.
sunken seal aparita bedesook Rob.
swim, to thoowidgee ; Rob.
sword bidisoni ; bedisoni Rob.
tea butterweye.
teeth botomet onthermayet ; bofomet outhermayet Rob. ; bocbodza Leigh.
ten shánsee ; theant Rob.
tern geonet.
thank, to ; I thank you thine.
thin ashei.
thigh itweena Rob.
thirteen see shendeek.
thirty see shendeek.
thread meroobish.
three shendeek ; shedsic Rob.
throat tedesheet ; iedesheet Rob.
throw, to pugatholte.
thumb boad ; pooeth Rob. ; itweena is *thigh*, Rob.
thunder baroodisick ; Rob.
ticklas gotheyet.
tickle kadimishuite ; kaduishnite Rob.
tilt camp see meotick.
tinker osthuk ; oothook Rob.
tobacco nechwa.
to-morrow máduck.
tongue memasook ; Rob.
trap lathun ; shabathoobet ; shebathoont Rob.
tree annŏŏ-e ; annooce Howley.
trousers mowead ; mooweed Rob.
trout dattomeish.
twelve see adzeech.
twenty see adzeech.
twine ardobeeshe.
two adzeech ; Rob.
upper shedbasing.
vessel (*ship*) adoltkhtek ; mamashee ; adothe Rob.
vessel, see *cup; small stone vessel*, see shoe-wana.
walk, to woothyat Rob. ; see wothamashet.
warm bŏŏbasha.
warming yourself obosheen.
watch kewis ; ruis Rob.
water-bucket shoe-wana.
water ebanthoo ; ebáutho Rob. ; *to drink water*, see ebathook.
water, salt, mássooch.
wet see wabee.
whale's tail owasboshno-un.
white wobee, wabee.
white man see bakashaman ; and *boy*.
white girl emamooset.
white wife adizabad zea.
white woman emamoose.
whole, see wáthik.
whortleberries mamoose Rob.
wife anwoyding, oosuck ; osuk Rob.
wife, white adizabad zea.
wigwam meotick.
wind gidyeathuc ; Rob.
wolf moisamadrook ; Rob.
woman emamoose ; amamoose Rob. ; see *Red Indian woman, wife*.
wood adiab Rob.
woodpecker shebohoweet ; Rob.
woods see *tree*.
yawn, to ibeath Rob.
yes yeathun.

Composite Photography applied to Handwriting. By Dr. Persifor Frazer.

(*Read before the American Philosophical Society, January 16, 1886.*)

The following preliminary note on this subject appeared in the Journal of the Franklin Institute for February, 1886:

Francis Galton was the first to point out in fugitive memoirs, and notably in his important work, "The Human Faculty," that one could sift the common from the accidental features of a number of objects by exposing them in succession to a sensitized plate in such a manner that the images of the similar parts of the different objects should occupy as nearly as possible the same parts of the plate; and that each object should be exposed for only a fraction of the length of time necessary to complete a picture on the film used. This fraction depended generally, if not always, on the number of objects and on the sensitiveness of the film. For example, if there were eighteen objects and the plate took thirty-six seconds to develop, each object would ordinarily be exposed for two seconds. It is easy to see that the result in the finished picture would be that those features which all the objects had in common would be re-enforced by each separate exposure, whereas those features which were accidental or variable, and which would be different for every individual, would be exposed for but two seconds and would be so indistinct as practically to fade away. Where the object was to catch a family likeness by exposing all the members male and female to the same portion of the plate, the result is a curious medley of faint whiskers and moustache; of hair parted in the middle and at the side; of female gowns with buttons to the throat and of male shooting jackets thrown open. But out of all this faint halo of confusion and blur, there starts a characteristic face which is the family type. Very often, too, this type-face resembles noticeably two different members of a family between whom no one can find a resemblance. It is this latter fact (which might have been expected) that induced me to look to the process for aid in solving the problem of identity of origin in handwriting. When a number of animals of the same race are thus treated, the method secures the fixing of the race or family characteristics, etc., as the case may be. When a number of pictures or coins bearing different representations of the same individual or scene are the objects, the result is to obtain either the average appearance of the same thing under different conditions (as for instance a man at different times of life), or the average of the impression made by identically the same thing on different artists. In this case, the merit of the process is that it constructs its image out of all that many pairs of trained eyes have seen, without giving undue weight to any one pair. So far, then, these efforts have been directed to re-finding a lost or concealed existence through multiple testimony, very much as the law tries to get at the truth by examining a number of witnesses.

At first sight one would suppose, however, that the case of handwriting

was a different one, but I think that the analogy with the above cases will appear strong on due reflection. With a given mental image of what one desires to write before one; and with a given relation of will-power, nerve sensitiveness and muscular force, the same signature could be repeated a thousand times, provided that all these conditions were invariable, and no others were superadded. So far from this being the case, however, every one of the factors just named which produce a signature, depends on physical and mental—in other words, on extraneous influences, to a very large degree. The movement commenced to effect an up stroke is met by an unexpected obstacle in the paper, a slight twinge in the shoulder, or a sudden noise, and the resulting line would show (were we sufficiently cognizant of the detailed working of all the complicated parts of our mental machinery to interpret it) just the order in which our different sentient and executive functions have been affected, and to what extent. But while these ever-recurring accidents result in preventing any signature from being made exactly as intended,* the fact that no two of them effect the same kind or amount of deviation leaves it in the power of the experimenter to extract from this process the "ideal" signature—a signature which probably never was seen as it appears, and yet which so combines all the visible results of a particular will acting on a particular arm to trace on paper a known design with a pen or pencil, that it may justly be called the *type* signature of that writer. What was said of the resemblance of every object of a group of objects which have any claim to be associated together, to the composite made of that group, even though it differ widely from other members of the same group; is true of handwriting. It has been remarked that the composite signature is an ideal, and never was realized. This is because the lines along which the strongest re enforcements are made are those where locally varying deviations most frequently cross. To put it in another form, suppose the lines a b, c and d to be in agreement as follows: At the point a', b does not cross, but c and d do. At b', c does not cross, but d and a do. At c', d does not cross, but a and b do. The line which would represent to the eye part of the ideal signature, would be that traced the points a', b', c', d', because those points having superposed lines of three out of the four signatures and would be darker, while the variations at each of these points would be indistinct.

In examining with care a composite signature as just described, it at once arrests the attention that the variations are not equally distributed over the entire body of the letter, but that there are regions of each letter where variations of a particular kind are noticeable, and other regions where there are few or none. The more the manuscripts of an individual are compared the more forcibly does this fact appear, until finally one is tempted to conclude that after a handwriting is once formed, it cannot

*The word "intended" is used to imply the effect which would be produced by the action of the will through the hand on the paper if not modified by these accidents, and not solely conscious intention.

naturally exhibit deviations except within a defined variation and in certain limited areas adjacent to the separate letters. It is thus as great an assistance to the observer to study the variations, as to study the ideal signature. Indeed, the variations are all important in the matter of identification, and if there were no variations the method would be inapplicable, because an exact copy might be made by tracing. A comparatively small number of signatures will give the maximum and minimum of variation in any given region of one of the letters forming it. Moreover, the kind of variation is easily observed where there are a number together, so that the most perfect adept at forgery could hardly hope to simulate the microscopically minute characteristics of variations which are simply the visible expression of a series of indefinitely complex relations of muscle and nerve.

In a case which was recently brought before the Orphans' Court in Philadelphia, this principle of composite photography was for the first time applied by me to the purpose of identifying handwriting, and from the experience thus far gained, it is thought that it will (at least in many cases) more surely lead to the truth than will the mere opinions of the most skillful expert.

Philadelphia, January 19, 1886.

We judge of force and weakness; of the stability and instability; of expression and character chiefly by applying the experience that we have gained through the observations of our lives to the images we see before us. In the more complex studies of nature the image is rendered in colors and their shades, and all these increase almost indefinitely the delicate phases and modifications of the thought which is suggested. They are just so many words added to the language in which external nature speaks to us.

But an almost infinite number of facts are impressed on our minds with convincing force without recourse to other than the plainest and simplest combinations of lines. A being, whether civilized or savage, recognizes instantly the impossibility of a tree growing with its roots in the air, or a man standing on the vertical face of a wall. The French caricaturists have demonstrated how much of character and expression may be given by a few lines which when looked at minutely resemble the scrawls of an infant on a sheet of paper, yet when viewed from a certain distance in its general effect tell us a whole story without the use of a word. It is undeniable that the power to do this is based upon the fact that certain accentuated lines appear in the figures of men and things under a given set of circumstances, and by taking these and omitting all else we have a sort of skeleton image divested of unessentials. This skeleton image is in its way a sort of composite, arrived at, it is true, by a different method from that here employed, but nevertheless representing the sum of the artist's experiences in a great many more or less similar cases, and the greatness of the historical painter lies just in his power to represent an important event or

crisis by the effects which it makes visible on those who are participators in and spectators of it. Here is no place to admit variation, the attitudes, or, in other words, the lines of the figures in such a composition must be normal and intelligible to the mass of mankind; must be, in short, a composite or abstraction of the lines that would survive were a hundred thousand such scenes to be instantaneously photographed: all else weakens the effect intended. Composite photography is a method of obtaining the essence of a number of objects and, in so far as those objects are typical of similar phenomena, of recording the relations of things to each other, the effects produced by a certain force or certain forces on matter. The composite will enable the mind, armed with some experience in life, to ascend from the individual cases to the underlying cause or motive.

Is it necessary, then, to prove that a line made by a human arm and hand is liable to the variations which such an arm or hand must produce when influenced, as they always are, by indefinitely numerous physical and mental forces? Is it necessary to devote much time to the proof that a line on paper so produced is as much a resultant of organic processes as the outline of the human figure or the expressions of the human face? It is a kind of fossil like the print of a footstep or of a leaf which, while it consists of nothing having life, or that ever need have had life, and possesses none of the material of the body which made it, is capable like the impressions above referred to of telling a great deal of the characteristics of its creator: it is, in fact, as organic as the forms of living things by which we judge them, for their forms or images do not possess life either.

Such methods as composite photography, or composite drawing or painting of any kind which can be accomplished when the hand has the skill to reproduce what the memory has stored away, are applicable only to the representation of resultants which do not vary within too wide limits, and are especially applicable where such variations depend upon the influences brought to bear on sentient things, and when they do not occur *per saltum*, but gradually and by imperceptible steps.

If the purpose be to represent an average of some object which presents images differing radically from each other at successive views there must be a very large number of such images selected to photograph, and then an ill-defined but darker blur will show vaguely on what part of the field on the whole the images have been most numerous. For phenomena of this kind the method is not adapted to offer its best results, though it still may be used to ascertain some facts in a general way.*

The attempt to apply the composite system of photography to the curves representing the rate of mortality in cities and towns, or to the

*In a pleasant letter received from Mr. Francis Galton, F. R. S., in answer to a copy of the preliminary note given above, which I sent him, he mentions that an attempt was made at the Kew Observatory to apply the principle of composite photography to the meteorological charts, without great success, though with more than Mr. Galton would have anticipated.

changes of the weather, &c., &c., is not likely to be rewarded by striking results, except to the extent which I have stated above, because these curves are composed of data taken at such intervals of time that there is no necessary sequence between them; they are affected by causes which are in no respect to be likened to the gradual unfolding of human expression by relaxations and constrictions of the muscles, the sum of all the changes not perceptibly altering the field first obtained, but altering the "values," as the artist calls it, or the relative importance of the rôles assumed by each unit of the image to the rest. These changes are as characteristic and delicate in the line made voluntarily by a living being as in the lines which its form involuntarily makes on the retina, and therefore one set is as susceptible of concentration and averaging as the other.

The merely formal and always repeated parts of a letter or other document have an entirely different character value from those parts which are composed of words and letters thrown together to represent a certain state of things, and which may never be repeated in exactly the same order. Obviously no composite of phrases can be expected unless the phrase have a technical significance, but separate words can be selected to form bases of composites, or even the two or three words which enter into an idiom, one of those well-trodden short cuts of language to a given idea. Such partial phrases (rendered frequently in other languages by a single word), as "in order that;" "as well as;" "not only;" "but also," &c., will be found in the handwriting of any one accustomed to write much, and may be taken as elements out of which to construct composites of the words of which they consist; but the value of such elements in helping one to a knowledge of the character of the person who penned them, or even of the general character of the writers' handwriting is not as great in these cases as it is in the signature and the few formal words which precede it in a letter. There are several reasons for this; one is that these formulas occur in different connections with the accompanying text, indicating very different attitudes of mind in the several cases. The sense of what is written must have a large influence in the manner of writing it, and therefore the letters composing these words will be larger or lighter; or more or less quickly and angularly written as the idea of the sentence by reflex action evokes different emotions in the mind of the writer. A circumstance equally noticeable will be the place on the paper which the words occupy; whether there is an abundance of room to write the words, or whether they are cramped in order to bring them into a smaller space. In cases where the words of such a subphrase are divided between two lines, they will almost surely not appear as they would when they follow each other in their natural order. But more even than these is the fact that the signature and its connected words, "Yours truly," &c., are always indicative of the task completed, the information conveyed. They are words of ceremony and endorsement, no matter what the contents of the letter may be. They are invariably repeated and come to be a purely conventional sign, of which the

parts resemble more or less the letters in the body of the writing in different people. This symbol usually occupies very nearly the same part of the page—at least as to its distance from the right or left hand edge of the paper—and this tends to fix it as a distinguishing sign. All these facts lead to a distinction between a signature, and that writing by the same hand which accompanies original composition.

There are, of course, peculiarities in every hand which can be traced both in the signature and in the body of the text. Such are very apparent when the writer labors under a physical disadvantage, such as a maimed or deformed hand or arm, but in lesser degree these peculiarities are present in every handwriting and constitute the general constant of "will-power, nerve sensitiveness and muscular force" employed by a given individual in this perfunctory habit.

I say *general* constant to imply that this relation must be regarded without paying too much attention to detail, for probably on no two occasions of a man's life do these factors exist in him in *absolutely* the same proportions, and even if they did, the least change of environment would alter the results thus accomplished. But the signature of a man being divested as much as possible of the accidents due to his outside influences, it follows that the signature is the production of his hand least likely to yield an insight into his condition when writing it. On the other hand, the fact that he selects one particular way of expressing his identity bestows upon it something of a resultant of the various motives which actuate him, and makes it a sort of digest of the points of his character called into play in the performance of the act. We may look for the same sort of character in a signature that we find in a photograph or a picture, and the same causes may prevent either the one or the other from faithfully representing the peculiarities of the individual, by representing that individual as he appears when conscious that he is being observed; or, in other words, a character is assumed which corresponds to the taste of the individual and represents more or less how he would like to be seen by the public. When the character is observed to exist throughout the entire mass of his writing, it may be assumed that it represents accurately the man, for no amount of patience and study would enable one to retain such peculiarities under all the varied circumstances attending the act of writing, if it were not inherent in the individual himself. In any case, however, the result is a likeness which all who know the original will recognize, even though one or two features may be made more prominent in pose than in repose, and that constitutes the chief value of the analysis of signatures for identification independently of what we may learn from them of the mental attributes of their signers.

It is not swe ylaantirely obvious how signatures with many light flourishes, or accompanied by intricate lines connecting their several parts, should be superposed, for these appendices are so easily affected by minute causes that it seldom happens that two will cover each other exactly. It is not to be expected that such parts will survive in the resulting type signature, but the breadth of the space covered by the blur and parallelism of the

faint lines will give evidence of the extent to which these ornaments have grown from caprice to a habit.

As a general rule there are several places—sometimes as many as eight or nine in a long signature—when the darkening of the lines indicates a general conformity of the pen's path to one direction, and it would seem that these places were not peculiar to any one part of a letter, nor that they were less in a hair line than in a heavy stroke. They appear to be dependent upon the anatomy and muscular structure of the individual in connection with his method of performing the act of writing his signature. For instance, some writers can only form one or two letters without moving the writing hand; only a word or so without shifting the elbow; others describe with the forearm of the writing hand a curve around the elbow which remains stationary; others slide the forearm along into parallel positions while writing. All these habits have different effects upon the handwriting which results, though they are not always to be easily detected, owing to the fact that other habits are cultivated at the same time to counteract the defect which each of these methods, when not so compensated, would have impressed upon the appearance of the chirography.

Thus, he who writes with an elbow pivoted immovably upon the table must learn to move the fingers over a greater space at some part of the line, to avoid the curve which would unconsciously result. This more vigorous movement of the fingers is likely to produce heavier strokes in the part of the signature where the compensation is naturally applied. So that a fixed elbow and heavy letter in the middle of the signature may stand to each other in the relation of cause and effect.

In signatures when the divergence is wide and the agreement correspondingly small, it has been my custom to use the dark portions as centres to adjust the various signatures on, and this plan will sometimes furnish a good composite when other plans fail.

Desiring an illustration to accompany this paper, I sought a signature which would serve as a fair test of the process. Manifestly such a signature must be well known to a large number of persons, and enough examples of it must exist to bring out the type character of their combination. Those individuals whose signatures are known to the largest number of persons are usually bankers or persons authorized to sign firm drafts, checks, &c., and these not unnaturally object to having the minutest characteristics of their writing brought to the knowledge of the public, though for the reasons stated above a study of what the composite teaches would convince the intending forger that his task was a far more difficult one than that of simply reproducing a design. On the other hand signatures of dead bankers and dissolved firms soon pass out of the remembrance of those who were once familiar with them, and therefore have no more significance than the sign manuals of unknown writers, or those which are purely fictitious.

George Washington's signature was one of the first to suggest itself, because many persons were familiar with it, and there are numerous

well-authenticated documents in existence which bear it; but it has proved to possess other advantages which were not known when it was selected. As in everything else, Washington was deliberate, painstaking and uniform in his method of writing his signature and the consequence is that it makes an excellent composite for illustration.

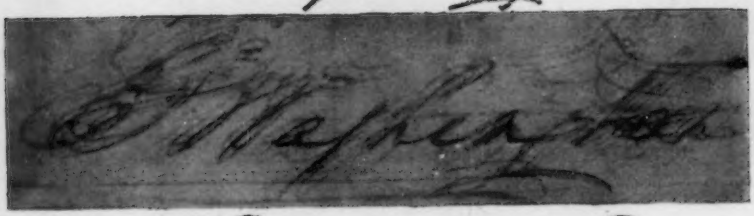
In writing his signature Washington put pen to the paper five times. First he wrote the "G W" in one connected line. Secondly, he raised his hand and made the small "o" between the upper parts of the G and W, and the two dots which appear in all but signature No. 7. Thirdly, his hand and arm were placed in position to write "ashing," these six letters occupying a breadth of almost exactly $1\frac{3}{4}$ inches in every signature except the third, when they are extended to $1\frac{7}{8}$ inches. This is about as much of the arc of a circle (of which the centre is the elbow pivoted on the table) as one with a forearm of average length can cause to coincide with the tangent, or the straight line across the paper which the lower parts of the letters follow, unless unusual effort be made and a great deal more movement be given to the fingers. The "g" ends in a curved flourish, of which the convex side is turned upwards below the right centre of the name. [Note. The lower loop of the "g" in all the signatures and in the composite was cut off in preparing the plate.] Fourthly, he wrote the final "ton." Fifthly, he added the very peculiar flourish above the right centre of the name, with the object of dotting the "i" and crossing the "t" at the same stroke.

In examining the composite, the effect of these various separate movements becomes manifest in its strengthened portions. It is hardly possible that any one during the period of sixteen years, which these signatures represent, or from 1776 to 1792, should have so schooled his hand to write a long name that the first inch or so of the writing should always occupy the same relative position to the body of the signature. It would take at least that much action for the hand and arm and pen to be brought into normal signature-writing condition; and especially is this so when this part of the writing is accompanied by flourishes as it is in the case we are considering. The "G W" and the little "o" and the dots at the top were the prelude, after which the arm was moved into position to write the main body of the signature or the "ashing." Of course, from the manner of making the dots, and the extremely small space they cover, their re-enforcement of each other in the composite was almost impossible, and, in fact, like other subordinate characters, they disappear almost completely. This latter is the part of the name which one would have expected to exhibit the greatest amount of uniformity, as in point of fact it does, with the exception of its terminal "g," which shows more variation than any of the other letters, because at this point the limit of coincidence between the tangent line of the writing and the curve, of which the right forearm was the radius, had been passed, and a freer movement of the fingers was compensating for the increasing divergence. [Note. It is likely that Washington sometimes raised the hand between the end of the long "s"

1 G. Washington

2 G. Washington

3 G. Washington

4 

5 G. Washington

6 G. Washington

7 G. Washington

8 G. Washington

and the beginning of "h," but he does not appear to have moved the elbow. All but the second signature are consistent with this view, and in the 1st, 3d and 5th it is plainly indicated. In the others, as in the flourish above the sixth signature, the pen may not have marked.] The fourth separate act of the penman was the formation of the "ton" after a movement of the arm. The breadth of the space occupied by these three letters is from $\frac{4}{8}$ to $\frac{7}{8}$ of an inch, or considerably within the range of coincidence of the curve and straight line before referred to; and owing to this fact there is only a moderate degree of re-enforcement of the letters in the composite, because these letters might fall into the first or last parts of the 2-inch space which was the limit of movement with a fixed elbow. It is worthy of note that even in this case the middle letter of the three is darker in the composite than either of the outside letters. The fifth and last movement was the flourish which dots the "i" and crosses the "t" by one stroke. This was done in the freest of free hands—often, as it seems probable, without resting hand or arm on the table at all. Therefore there is no coincidence of the lines in this part of the composite and the *region* of variation is wider than that of any other part of the signature.

All the signatures used in the accompanying plate (seven in number) are unquestionably genuine. With the exception of one, which is the property of the writer, they were carefully chosen from a number of authenticated signatures in the possession of the Historical Society of Pennsylvania.

No. 1 is on a letter, dated December 18, 1776, from near the Falls of Trenton, and addressed to Washington's brother Samuel.

No. 2 is on a letter dated Headquarters, November 4, 1777, and is addressed to the writer's great-grandfather, Lt.-Col. Persifor Frazer, then a prisoner of war in Philadelphia.

No. 3 is on a letter dated September 27, 1777, and is to Wm. Henry, of Lancaster.

No. 4 is the Composite of all the rest.

No. 5 is on a letter dated Headquarters in Morristown, February 22, 1777. The person to whom the letter was addressed is not stated.

No. 6, dated September 26, 1793, is affixed to the commission of David Lenox.

No. 7, of the same date, is affixed to David Lenox's appointment as agent for the relief and protection of American Seamen.

No. 8, dated May 24, 1799, closes a letter to Thomson Mason.

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On the Structure and Affinities of the Amphiumidæ. By E. D. Cope.

(Read before the American Philosophical Society, February 5, 1886.)

By all authors, the genus Amphiuma has been included in the same family division with Protonopsis and Megalobatrachus until 1866. At that time the writer of this paper proposed to separate it from the latter genera as the type of a family Amphiumidæ, while the other genera were placed in another family with the name Protonopsidæ. This course has not been followed by later writers; in the Catalogue of the British Museum by Dr. Boulenger (1882), for instance, the three genera being included in one family, the Amphiumidæ.

The reasons for keeping the Amphiumidæ distinct from the Protonopsidæ were stated to be the following:*

AMPHIUMIDÆ: "An axial cranial bone (? vomer) in front of orbito sphenoids, and one forming palatal surface in front of parasphenoid. * Pariëtals prolonged laterally, not reaching prefrontals. Vestibule, wall osseous internally. Premaxillaries consolidated. Occipital condyles on cylindrical pedestal."

PROTONOPSIDÆ: "No anterior axial cranial bone. * * Pariëtals and prefrontals prolonged, meeting and embracing frontals. Wall of vestibule membranous internally. Premaxillaries separated. Occipital condyles sessile."

The following observations were made on the Amphiumidæ: "The occipital condyles and temporocervical tendon are quite as in Desmognathus; they have not been previously described.† In *Amphiuma means* there is a minute not articulated bone on the suture between the o. o. frontalia and prefontalia in the situation of the lachrymal. There are some approximations to Cæcilia in Amphiumidæ. It does not appear to have been noticed that the * * free margin of the frontal seems to foreshadow the overroofing of the orbit and temporal fossa seen in Cæcilia. There is also a very large foramen or canal passing through the o. maxillare from near its middle to the orbit, foreshadowing the *canalis tentaculiferus* of Cæcilia: a narrow one occurs in the same situation in Protonopsis. Further the prominent horizontal anterior inferior processes of the vertebral centra are the same in Amphiuma and Cæcilia."

Occasion for the revision of these views having presented, the following facts and conclusions have been reached.

The characters assigned as above to the two families Amphiumidæ and Protonopsidæ are abundantly sufficient for retaining them as distinct. The form of the occipital condyles might be excepted from this estimate, and the axial bone in front of the parasphenoid proves to be abnormally cut off in the specimen then examined. The Protonopsidæ agree with other

* Journal Academy Philadelphia, 1866, p. 104.

† They were described by Dr. J. G. Fischer, Anatomisch. Abhandl. üb. Perennibranch. u. Derotrem. Erstes Heft, p. 61 1864.

Urodela in all of the characters given, except in the exclusion of the frontals from the supraorbital border, and in the membranous characteristic of the internal wall of the vestibule. The Amphiumidæ differ from other Urodela in the presence of a large ethmoid bone (the one referred to as ? vomer in the diagnosis above quoted), in the presence of temporal ridges, and of two anteriorly directed hypapophyses of the precaudal vertebræ.

It is interesting to notice that three of the four characters just cited are shared by the Cæciliidæ. The presence of the ethmoid is of especial importance, as it is an element constantly wanting in the Urodela. I have not found it in Desmognathus, Anaides, Spelerpes, Amblystoma, Salamandra, nor Protonopsis; nor is it present in Necturus or in Siren. It is, on the contrary, always present in Cæciliidæ* (see Plate v, E). The double anterior hypapophyses are otherwise confined to the same family.

The Cæciliidæ are generally regarded as representing a distinct order, which bears the names Apoda, or Gymnophiona. The definition given to this order by Mr. Boulenger† is: "No limbs; tail rudimentary. Males with an intromittent copulatory organ. Adapted for burrowing." Of these definitions none is of ordinal value. The tail in some species is distinct. The intromittant copulatory organ in *Dermophis mexicanus*, *Gymnopis proximus*, and *Herpele ochrocephala*, is not an especial organ, but is merely the everted cloaca. The hard papillæ observed by Günther‡ in the *Ichthyophis glutinosus* are wanting in the above species. The protrusion of the cloaca is effected by two especial muscles, which are wanting in Amphiumidæ. As to limbs, their extremely rudimentary character in Amphiuma is well known. To regard their condition as indicating ordinal separation from the Cæciliidæ is not in accordance with our practice in similar cases in the Reptilia, as in the order Lacertilia. The characters of these parts and their supporting arches not having been heretofore given, I describe them below.

I have endeavored to sustain the order Gymnophiona by the character of the fusion of the nasal and premaxillary bones found in the majority of the genera.§ But Stannius‖ shows that these bones are distinct in Ichthyophis. Huxley states (Anatomy of Vertebrate Animals, p. 155) that in *Ichthyophis glutinosus* a distinct bone nearly encircles the orbit. This he compares to the supra and postorbital bones found in the Stegocephali. But in Chthonerpeton, Cæcilia, Dermophis and other genera, this bone forms part of the maxillary, so that it is not characteristic of the family, and may not be homologous with the bones which occupy the same position in Stegocephali. Wiedersheim calls it maxillary.

With these facts in view I have united¶ the Cæciliidæ with the Urodela,

* See Wiedersheim, Anatomie der Gymnophionen, Jena, 1879.
† Catalogue of the British Museum, 1882, p. 88.
‡ Reptiles of British India (Roy. Society), p. 441.
§ American Naturalist, 1884, p. 26.
‖ Zootomie der Amphibien, 1856, p. 44.
¶ American Naturalist, 1885, p. 244, note.

a proposition which I now fully believe to be sustained by the evidence. *The Cæciliidæ is a family of Urodela, connected with the typical forms through the Amphiumidæ.*

Wiedersheim (l. c. p. 95) has attempted to trace the ancestry of the Cæciliidæ to the Stegocephali of the Carboniferous period, from which he supposes them to have arisen by a process of degeneration. He remarks that in order to demonstrate this proposition it is only necessary to discover a type with rudimental limbs which shall connect the two.

That the Cæciliidæ is a type which has resulted from a degeneration, I have also proposed,* but I have derived them from the Urodela rather than from the Stegocephali direct. They have, like Amphiuma, essentially the same cranial structure as the Urodela, which is widely different from that of the Stegocephali, in the absence of the intercalare, supratemporal and postorbital bones. And these characters are fully maintained in various genera of Stegocephali which have rudimental limbs. Amphiuma then is the annectant type with rudimental limbs, which Dr. Wiedersheim sought for. The circumstance that his eyes were turned towards the Stegocephali indisposed him to recognize this fact.

The only portion of the shoulder girdle of this genus which is ossified is the scapula. The coracoid cartilages of opposite sides are distinct from each other, and there is a production of the præcoracoid region. The humerus is truncate at both extremities, making its articulations with cartilage only. The carpus is undivided cartilage. The osseous ilium is quite short and slender; it has a long superior cartilaginous portion, which is attached to an equally long cartilaginous sacral rib. The inferior element is an undivided plate, which is wider than long, and presents an obtuse angle anteriorly. The posterior portion of each is occupied by a round discoid ossification, which forms the posterior border, but does not reach either the acetabulum or its fellow. The femur is rather long and has a distinct trochanter, but no head nor condyles. The articulations are cartilaginous, as is the tarsus, which is also undivided. The tibia and fibula are about one-sixth the length of the femur, and the fibula is a little shorter and more slender than the tibia. The phalanges in both feet are well ossified.

The general characters of these parts are described in Stannius' Handbuch der Zoötomie,† but only as included in the definitions of the order to which Amphiuma is referred.

Plate VI.

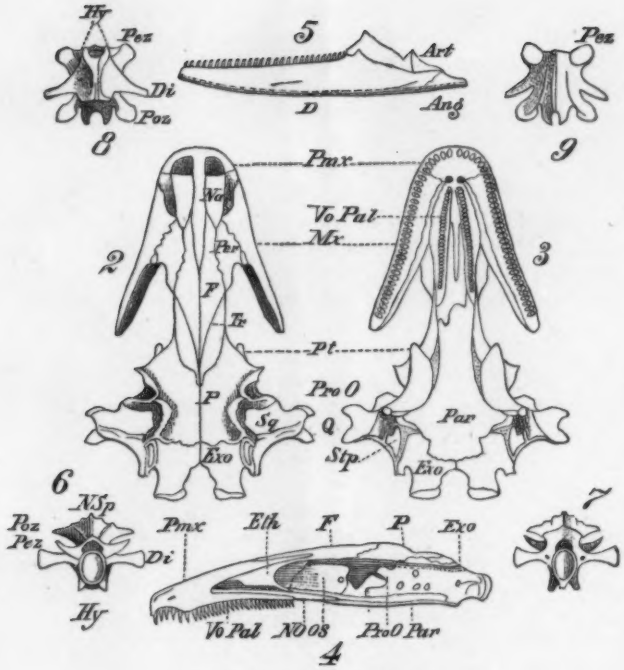
Amphiuma means Gard. One-third natural size. Original. From Georgia.

Fig. 1, skull, left side.

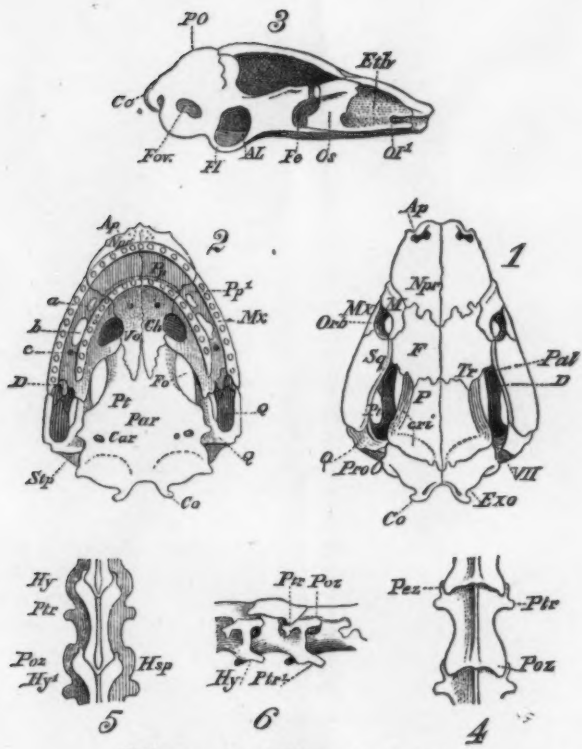
Fig. 2, do. from above.

* American Naturalist, 1885, p. 244.

† Rostock, 1856.



Amphiuma means Gard.



Chthonerpeton indistinctum R. and L.

Fig. 3, skull, from below.
Fig. 4, do. right half, from within.
Fig. 5, left mandibular ramus, external view.
Figs. 6–9, an anterior dorsal vertebra; fig. 6, front; 7, rear; 8, bottom; 9, top.

Plate VII.

Chthonerpeton indistinctum R. and L. Three-eighths nat. size. After Wiedersheim. From Brazil.
Fig. 1, skull, from above.
Fig. 2, do. from below.
Fig. 3, do. left half, from within.
Figs. 4–6, one and parts of two other vertebræ; 4, from above; 5, from below; 6, right side.

EXPLANATIONS OF LETTERS.

Pmx., Premaxillary.
Mx., Maxillary.
Na., Nasal.
Npr., Nasopremaxillary.
Pef., Prefrontal.
F., Frontal.
P., Pariëtal.
Tr., Temporal ridge.
Sq., Squamosal.
Exo., Exoccipital.
ProO., Proötic.
OS., Orbitosphenoid.
Eth., Ethmoid.
Par., Parasphenoid.
VoPal., Vomeropalatine.
Pt., Pterygoid.
Stp., Stapes.
Q., Quadrate.
Co., Occipital condyle.
Art., Articular.
Ang., Angular.
D., Dentary.
Di., Diapophysis.
Prz., Prezygapophysis.
Poz., Postzygapophysis.
Hy., Hypapophysis.
Hsp., Hypapophysial spine.
NSp., Neural spine.
Ch., Posterior nares.
Ap., Anterior nares.
a, Naso-palatal foramen.
b, " " "
c, " " "
Car., Carotid foramen.
Orb., Orbit.

Stated Meeting, March 19, 1886.

Present, 19 members.

President, Mr. FRALEY, in the Chair.

Lieut. A. W. Wyckoff, U. S. N., Dr. Owen Jones Wistar, and Dr. Charles A. Oliver, were presented to the Chair and took their seats.

Donations to the Library were reported from China Branch of the Royal Asiatic Society; Physikalische Central-Observatorium and K. Akademie der Wissenschaften, St. Petersburg; K. K. Naturhistorische Hof-Museum and K. Akademie der Wissenschaften, Wien; Nassauische Verein für Naturkunde, Wiesbaden; Astronomische Nachrichten, Kiel; Deutsche Geologische Gesellschaft and Verein zur Beförderung des Garten Baues, Berlin; Physikalisch-Medicinische Gesellschaft, Erlangen; Società Toscana di Scienze Naturali, Pisa; Société de Géographie and Mr. H. Welter, Paris; Statistical Society, Hong Kong; Meteorological Office and "Nature," London; Philological Society, Cambridge, England; Manchester Literary and Philosophical Society; Institut Canadien-Française, Ottawa; Canadian Institute, Toronto; Harvard College, New Haven; Publishers of the "Traveller's Record," Hartford; Dr. L. B. Bush, of New York; Brooklyn Entomological Society; Trenton Natural History Society; Franklin Institute, Pennsylvania Historical Society, College of Pharmacy, Dr. D. Jayne & Son and Mr. Henry Phillips, Jr., Philadelphia; Delaware Historical Society; American Chemical Society and American Journal of Philology, Baltimore; United States Naval Institute, Annapolis; Department of State, Hon. Samuel J. Randall, John H. Hickcox, and Engineer Department, Washington; Editor of "The Industrial South," Richmond; Denison University, Granville; Publishers of the "Engineering Era," Cleveland; Washburn College, Topeka; University of California; Mr. Juan Ignacio de Armas of Havana; Deutsche Wissenschaftliche Verein zu Santiago.

A chair was presented on behalf of the Executors of the

late Dr. George Hamilton, of this city, formerly the property of Dr. Chapman, sometime the President of the Society, to whom it had been given by Joseph Bonaparte, ex-King of Spain, from his residence at Bordentown, N. J.

A letter accompanied the gift from Mr. J. McClure Hamilton, the son of the donor, to whom the thanks of the Society were voted.

Letters accepting membership were read from Prof. F. A. Genth, Jr. (Philad'a, March 15th, 1886); Ensign Louis Duncan, (U. S. S. S. *Juniata*, New York Navy Yard, March 15th, 1886).

A letter of envoy was read from the Statistical Society of London, and also asking for certain of the Society's publications, which was referred to the Secretaries with power to act.

A letter was read from the Institute Canadien-Française requesting exchanges, which was similarly referred.

A letter was read from Dr. Clemens Winkler, Freiberg in Sachsen, announcing the discovery by himself of a new non-metallic element to which he had given the name of *Germanium*.

The death of Dr. Austin Flint was announced as having taken place at New York on the 13th day of March, 1886, in the 74th year of his age.

The Lackawanna Institute of Science at Scranton, Pa., was ordered to receive the Catalogue of the Library of the Society and the Proceedings, to begin with No. 117.

Secretary Brinton presented two papers by Dr. W. J. Hoffman, one on the Selish Language and another on the Waitshumni Dialect.

Dr. Horn explained the process among the Piutes of sweetening acorn meal by percolation with water so as to render the product edible.

Lieut. Wyckoff made a verbal communication on the action of heavy vegetable or fish oils in reducing heavy combing waves to long swells that would not injure a vessel. A discussion upon the subject ensued which was participated in by Messrs. Brinton, Dudley, Horn, Holland, Ingham and Oliver.

Various diplomas of Dr. Franklin's were exhibited, lately found in the possession of the Society.

Pending nominations Nos. 1078 to 1103 and new nominations Nos. 1104 and 1105 were read, and, after reading the minutes, the Society was adjourned by the President.

Stated Meeting, April 2, 1886.

Present, 15 members.

Vice-President, Dr. RUSCHENBERGER, in the Chair.

Lieut. Geo. B. Anderson, U. S. A., West Point, N. Y., and Prof. Serge Nikotin, Geological Survey of Russia, St. Petersburg, Russia, newly-elected members, by letter accepted membership in the Society.

Donations to the Library were announced from the following sources, viz: South African Philosophical Society, Cape Town, Africa; Geological Survey of India; Société Impériale des Naturalistes de Moscow, Russia; Zoologischer Anzeiger, Leipzig; Prof. Reuleaux of Berlin; Senckenbergische Naturforschende Gesellschaft, Frankfort-am-Main; Oberlausitzer Gesellschaft der Wissenschaften, Görlitz; Verein für Erdkunde, Halle A. S.; Prof. G. vom Rath of Bonn; Prof. E. Renevier of Lausanne; K. Nordiske Oldskrift Selskab, Copenhagen; R. Accademia dei Lincei, Rome; R. Accademia de Scienze Lettere ed Arti, Modena; R. Academia de la Historia, Madrid; Bureau des Longitudes, Société Zoölogique de France, École Polytechique, Musée Guimet, Société de Géographie, and Prof. Léon de Rosny, Paris; Académie de Dijon; Royal Society, Royal Geographical, Meteorological and Astronomical Societies, Society of Antiquaries, Geological Society, Bath and West of England Society, and the publishers of the "Diplomatic Review," London; Philosophical and Literary Society of Leeds; National Board of Trade, Boston; State Museum of Natural History and Geological Survey of New York, Albany; Engineers' Club of Philadelphia; University of Pennsylvania, Philadelphia Board

of Trade, Publishers of the "American Naturalist," Mr. Henry Phillips, Jr., and Dr. J. Minis Hayes; Dr. J. Curwen of Warren, Pa.; the Johns Hopkins University; U. S. Fish Commission, U. S. Geological Survey, Philosophical Society of Washington, D. C.; University of Virginia; Georgia Historical Society; Rev. Stephen D. Peet of Chicago, Ill.; Mercantile Library Association, San Francisco, and the Imp. Observatorio do Rio de Janeiro.

Photographs for the Society's album were received from Lieut. A. B. Wyckoff, U. S. N., Hon W. Townsend, and E. F. im Thurn.

On motion, the President was requested to transmit the thanks of the Society to the Royal Society for the gift of its Catalogue of Scientific Papers.

On motion, the South African Philosophical Society (Cape Town), and the Oneida County (N. Y.) Historical Society were placed on the exchange list to receive Proceedings from No. 96.

Acceptances of Membership: Prof. Serge Nikotin (St. Petersburg, March 12, 1886), Lieut. Geo. L. Anderson, U. S. Army (West Point, N. Y., March 22, 1886).

Letters of Envoy were received from the South African Philosophical Society, Cape Town, Africa; Bureau of Longitudes, Paris; Royal Society, Bath and West of England Society, and the publishers of the "Diplomatic Review," London; U. S. Geological Survey, Washington.

Acknowledgments for No. 122, as follows: Portland Society of Natural History; New Hampshire Historical Society; Profs. Robt. C. Winthrop and S. P. Sharples of Boston; Prof. H. A. Hagan of Cambridge, Mass.; American Antiquarian Society, Worcester; Essex Institute; Rhode Island Historical Society, and Rhode Island Society for the Encouragement of Domestic Industry; Connecticut Historical Society; Mr. Geo. F. Dunning of Farmington, Conn.; University of the City of New York; Astor Library; Profs. Henry M. Baird and John J. Stevenson of New York; U. S. Military Academy, West Point; Profs. James E. Oliver and T. Fred'k Crane of Ithaca, N .Y.; Prof. C. H. F. Peters of Clinton, N. Y.; New Jersey Historical

Society; Prof. W. Henry Green of Princeton, N. J.; Mr. Wm. John Potts of Camden, N. J.; Pennsylvania Hospital, The Numismatic and Antiquarian Society, College of Physicians, Prof. J. P. Lesley, Dr. Persifor Frazer, Messrs. Samuel Wagner, Henry Phillips, Jr., and Dr. Isaac Norris of Philadelphia; Mr. Thomas Meehan of Germantown; Dr. R. H. Alison of Ardmore, Pa.; Profs. Pliny Chase and L. B. Hall, Haverford College; Hon. W. Townsend of West Chester; Rev. J. A. Murray of Carlisle; the Wyoming Historical and Geological Society; Profs. Traill Green and J. W. Moore of Easton; U. S. Naval Institute; the Signal Office, and the Surgeon-General's Office, and Prof. J. H. C. Coffin of Washington; Leander McCormick Observatory; Virginia Historical Society; Prof. J. W. Mallet and Messrs. Schele de Vere and Jed. Hotchkiss of Virginia; Georgia Historical Society; Cincinnati Society of Natural History; Prof. James Morgan Hart, of Cincinnati; Prof. Leo. Lesquereux of Columbus, Ohio; Dr. Robert Peter of Lexington, Ky.; Prof. Daniel Kirkwood of Bloomington, Ind.; Chicago Historical Society; Prof. Henry S. Frieze of Ann Arbor, Mich.; State Historical Society of Wisconsin; Kansas Historical Society.

Dr. Frederick S. Krauss, of Vienna, acknowledged the receipt of his separata; Academia Royale Danoise des Science et Lettres (117, 118, 119); Société de Physique et d'Histoire Naturelle, Geneva (115, 116); Sig. G. Battista Rossi of Rome, Italy (117, 118, 119); Mr. Robert N. Toppan, of Cambridge, Mass. (117, 118, 119, 120, 121, 122); Lieut. A. B. Wyckoff, Drs. Charles A. Oliver and J. W. Holland of Philadelphia (121, 122); Mr. Heber S. Thompson of Pottsville, Pa. (Diploma and 122); Rev. Thos. C. Porter of Easton, Pa. (121, 122).

Committee on Prof. Cope's paper was continued.

Lieut. Wyckoff read a paper on the Use of Oil in Storms at Sea.

Mr. Ashburner gave a review at some length of the structural geological features attending the occurrence of natural gas.

Nominations Nos. 1078 to 1106 and new nominations Nos. 1107 and 1108 were read.

The rough minutes were read, and the Society was adjourned by the presiding member.

Stated Meeting, April 19, 1886.

Present, 11 members.

President, Mr. FRALEY, in the Chair.

Dr. John H. Brinton, a newly-elected member, was presented to the Chair and took his seat.

Donations for the library were received from the following: The Royal Society of Tasmania; Prof. Serge Nikitin of St. Petersburg; Zoologische Anzeiger, Leipzig; Prof. G. vom Rath of Bonn; Würtembergische Vierteljahrshefte für Landesgeschichte; R. Nordiske Oldskrift Selskab, Copenhagen; Academie Royale de Belgique; R. Accademia dei Lincei, Rome; Société Toscana di Scienze Naturali; Institution Ethnographique, Paris; R. Academia de la Historia, Madrid; Royal Society, "Nature," and Mr. William Blades of London; Ronsdon Observatory, Devon; Cambridge Philosophical Society; Yorkshire Geological and Polytechnic Society; the publishers of "The Citizen" and Mr. Hamilton Andrews Hill of Boston; Rhode Island Historical Society; American Journal of Science, New Haven, Conn.; New York Shakespeare Society; Oneida Historical Society, Utica, N. Y.; Brooklyn Entomological Society; College of Pharmacy and Hydrographic Office, Philadelphia; Johns Hopkins University; Chief Signal Office, Census Office and Mr. J. H. Hickcox of Washington, D. C.; Elliott Society of Science and Arts, Charleston, S. C.; State Historical Society of Wisconsin; University of California; Mr. C. B. Bradley of Sacramento, Cal.; Imperial Observatorio da Rio de Janeiro; Mr. S. H. Scudder, Cambridge, Mass.; Mr. Henry Phillips, Jr., Philadelphia.

Letters of acknowledgment were received as follows: Rev. H. Clay Trumbull and Rev. Daniel R. Goodwin of Philadelphia; Mr. John Haines of Germantown; Maryland Historical Society; Mr. Charles V. Riley of Washington; Cincinnati Observatory; Universities of Tennessee and California; Mr. George Davidson of California (122); Royal Society of Victoria (116, 117, 118 and Register of Papers); R. Accademia dei Lincei and R. Istituto Lombardo (117–120); Royal Institution and Radcliffe Observatory (121); Society of Antiquaries of London (120, 121); Mr. Robert N. Toppan of Cambridge, Mass. (119); Oneida Historical Society (96–122 and miscellaneous pamphlets).

Letters of envoy were received as follows: Oneida Historical Society, Utica, N. Y., and the Chief Signal Officer, U. S. Army, Washington, D. C.

Photographs were received for the Society's Album from Charles V. Riley of Washington, D. C., and Dr. Traill Green of Easton, Pa.

The death of John Welsh was announced as having taken place at Philadelphia on the 10th day of April, 1886, in the 82d year of his age, and on motion the President was authorized to appoint a suitable person to prepare an obituary notice.

The Committee on Prof. Cope's paper was continued.

Pending nominations Nos. 1081 to 1108, and new nominations Nos. 1109, 1110, 1111, were read, and the Society was adjourned by the President.

Stated Meeting, May 7, 1886.

Present, 4 members.

Mr. LAW, in the Chair.

Donations were announced to the library from the following sources: Mining Department, Melbourne; Physical Central-Observatorium, St. Petersburg; K. K. Geologische Reichs-

anstalt, K. K. Zoologisch-Botanische Gesellschaft, K. K. Central Anstalt für Meteorologie und Erd-Magnetismus, Vienna; Deutsche Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Munich; Prof. Dr. G. D. E. Weyer of Kiel; K. P. Akademie der Wissenschaften, Berlin; K. Gesellschaft der Wissenschaften, Göttingen; Naturwissenschaftliche Gesellschaft, St. Gallen; Académie Royale de Copenhagen; Statistika Central Byrån, Stockholm; Académie Royale des Sciences, &c., Bruxelles; Société de Geographie, Société Americaine de France, Institution Ethnographique and Prof. Léon de Rosny of Paris; Instituto y Observatorio de Marina, San Fernando; R. Biblioteca Nazionale Centrale di Firenze; Cav. Damiano Muoni of Milan; Royal Society, Royal Institution, Zoölogical Society, Royal Astronomical and Geographical Societies, "Nature," Journal of Forestry of London; Manitoba Historical Society; Canadian Record of Science, Montreal; American Academy of Arts and Sciences, Massachusetts Historical Society, Boston; Essex Institute; Yale College, American Journal of Science, New Haven; Meteorological Observatory and New York Academy of Sciences; Brooklyn Entomological Society; Buffalo Historical Society; Geological Survey of New Jersey; Franklin Institute, American Pharmaceutical Association, Board of Directors of City Trusts, Hydrographic Office, Mr. Henry Phillips, Jr. and the publishers of The American Naturalist, Philadelphia; Board of Commissioners of Public Charities of Pennsylvania, Harrisburg; Prof. Ira Remsen, Johns Hopkins University, and The American Journal of Archæology, Baltimore; Department of State and War Department, Washington; Messrs. A. C. McClurg & Co., Chicago; University of Michigan.

Letters of acknowledgment were received from the K. Danske Videnskabernes Selskab, Copenhagen (116 and Register of Papers); Lackawanna Institute of History and Science (117, 118, 119, 120, 121, Cat. Parts 1, 2, 3, 4); South Kensington Museum, Cambridge Philosophical Society, and University Library, Prof. Geikie (121); Dr. J. T. Rothrock and Prof. L. M. Haupt of Philadelphia (122); Zoological

Society of London (120, 121); Institut Canadien-Français, and the Manitoba Historical Society, Canadian Institute (121, 122); Annales des Mines, Paris (Trans. XIV, 2).

Prof. Cope requested permission to withdraw the paper offered by him for the Transactions on February 5, 1886, which on motion was granted and the paper was presented by him for the Proceedings.

On motion the Committee on same appointed February 5, 1886, was discharged.

Prof. Cope offered for the Transactions "A systematic catalogue of the Vertebrata found in the beds of the Permian Epoch in North America," which was referred to a Committee to be appointed by the President.

Dr. A. S. Gatschet of Washington, presented through the Secretaries a paper on The Beothuk Language (second paper); with a vocabulary.

Pending nominations Nos. 1081 to 1111 were read.

Dr. Frazer exhibited the map to accompany his Geology of York County, Pa., stating the colors were in accordance with the new International method of the late Geological Congress at Berlin. Dr. Frazer also exhibited a plate to accompany his paper on the application of Composite Photography to handwriting.

On motion the appropriation for the map was increased to $60 and that for the photographic plate to $56.

And the Society was adjourned by the presiding member.

Stated Meeting, May 21, 1886.

Present, 37 members.

President FRALEY in the Chair.

Donations to the library were received from the following: Geological Survey, of India; Naturwissenschaftlicher Verein, Bremen; Flora Batava, Leyden; Académie R de Belgique;

Société R. des Sciences de Liège; R. Accademia dei Lincei, Rome; R. Biblioteca Nazionale Centrale di Firenze, and Mr. Alessandro Chapelli; Institution Ethnographique, Paris; Royal Society, Royal Geographical Society, Meteorological Council, "The Asclepiad," "Nature," of London; and Sir Lowthian Bell, Prof. C. Piazzi Smyth, of Edinburgh; Boston Society of Natural History, Museum of Comparative Zoölogy, Cambridge; Free Public Library of New Bedford; American Chemical Society, New York; Historical Society of Pennsylvania, Zoölogical Society of Philadelphia, Engineers' Club, Fairmount Park Association, University of Pennsylvania, College of Pharmacy, Charles A. Oliver, M.D., Hon. Richard Vaux, Henry Phillips, Jr., and Prof. Edward V. d'Invilliers, of Philadelphia; Johns Hopkins University and Chemical Journal, Baltimore; U. S. Naval Institute, Smithsonian Institution; Col. Charles C. Jones of Augusta, Ga., and the Iowa State Historical Society.

Letters of envoy were received from R. Instituto di Studi Superiori in Firenze, and the Meteorological Office, London.

Letters of acknowledgment were read from K. K. Central-Anstalt für Meteorologie und Erdmagnetismus (120); Fondation de P. Teyler van der Hulst (120, 121); Prof. W. P. Blake, of New Haven (122).

Notice was received from "The Young Men's Association" and "The Young Men's Library," that they had consolidated, and changed their name to "The Buffalo Library."

On motion, the *Biblioteca Nazionale Centrale, Firenze, Italia*, was placed on the exchange list and ordered to receive the Proceedings of the Society from No. 121.

A letter accepting membership was read from Dr. Edward Pepper (Paris, May 7, 1886).

Prof. Cope presented for the Proceedings "An Analytical Table of the Genera of Snakes." He requested a plate for his paper on Amphiuma, which the Society ordered at an estimated cost.

Prof. T. B. Stowell presented through the Secretaries a paper on the "Trigeminus Nerve in the Domestic Cat," accompanied

by a plate; on motion the Secretaries were empowered to act on the application.

The President announced that he had appointed as a Committee on the paper of Prof. Cope, presented at the last meeting, Messrs. Allen, Jayne and Horn, who reported the paper worthy of publication, which was ordered by the Society.

The President reported that he had received and handed over to the Treasurer $129.33, the amount of the Michaux rentes due on the first of April, 1886.

The proceedings of the Board of Officers and Council were submitted together with the following resolution recommended by it:

"That the further consideration of the Report and the recommendations therein contained, which was referred to the Board of Officers and Council by resolution of the Society, March 5, 1886, be indefinitely postponed."

Dr. Frazer offered the following amendment to the resolution:

Resolved, That the Report of the Special Committee, appointed February 5, 1886, to examine, etc., etc., which has been referred to the Board of Officers and Council by resolution of the Society of March 5, 1886, be recommitted to the Special Committee just appointed with instructions to present it with such alterations and amendments as may seem desirable at the meeting of the Society on October 15, 1886.

A point of order was taken and it was decided by the President that a motion to postpone was entitled to precedence. And the question recurring on the resolution submitted by the Board, it was adopted by a vote of 26 yeas to 11 nays, the yeas and nays being demanded by Dr. Frazer.

This being the evening for the balloting for candidates for membership, the following gentlemen were declared duly elected members of the Society:

2073. Samuel W. Pennypacker, Philadelphia.
2074. John T. Napier, Philadelphia.
2075. William Spohn Baker, Philadelphia.
2076. Benjamin Sharp, M. D., Philadelphia.
2077. Henry Reed, Philadelphia.

2078. John Marshall, M. D., Philadelphia.
2079. Merrill Edwards Gates, New Brunswick, N. J.
2080. William K. Brooks, Baltimore, Md.
2081. Herbert B. Adams, Baltimore, Md.
2082. R. Somers Hayes, St. Louis, Mo.
2083. John C. Branner, Bloomington, Ind.
2084. Abel Hovelacque, Paris, France.
2085. Emil Levasseur, Paris, France.
2086. Victor Duruy, Paris, France.
2087. Marquis de Nadaillac, Paris, France.
2088. Francis Pulzsky, Buda-Pesth.
2089. Otto Donner, Helsingfors.
2090. Angelo de Gubernatis, Florence, Italy.
2091. Paul Albrecht, Bruxelles.
2092. Josef Szombathy, Vienna.
2093. Dionysius Stuer, Vienna.
2094. Edward Suess, Vienna.
2095. Aristides Brezina, Vienna.
2096. W. W. Skeat, Cambridge, England.
2097. J. P. Postgate, Cambridge, England.
2098. Richard C. Temple, Ambala, India.
2099. Lord Rayleigh, London.
2100. William Crookes, London.
2101. Francis Galton, London.
2102. Duke of Argyll, London.
2103. Jesus Sanchez, Mexico.
2104. Antonio Peñafiel, Mexico.

And the Society was adjourned at 10 o'clock by the President.

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him the communication, description, or model, except the officer to whom it shall be entrusted; nor shall such officer part with the same out of his custody, without a special order of the Society for that purpose.

6. The Society, having previously referred the several communications from candidates for the premium, then depending, to the consideration of the twelve counsellors and other officers of the Society, and having received their report thereon, shall, at one of their stated meetings in the month of December, annually, after the expiration of this current year (of the time and place, together with the particular occasion of which meeting due notice shall be previously given, by public advertisement) proceed to final adjudication of the said premium; and, after due consideration had, a vote shall first be taken on this question, viz.: Whether any of the communications then under inspection be worthy of the proposed premium? If this question be determined in the negative, the whole business shall be deferred till another year; but if in the affirmative, the Society shall proceed to determine by ballot, given by the members at large, the discovery, invention or improvement most useful and worthy; and that discovery, invention, or improvement which shall be found to have a majority of concurring votes in its favor shall be successful; and then, and not till then, the sealed letter accompanying the crowned performance shall be opened, and the name of the author announced as the person entitled to the said premium.

7. No member of the Society who is a candidate for the premium then depending, or who hath not previously declared to the Society, that he has considered and weighed, according to the best of his judgment, the comparative merits of the several claims then under consideration, shall sit in judgment, or give his vote in awarding the said premium.

8. A full account of the crowned subject shall be published by the Society, as soon as may be after the adjudication, either in a separate publication, or in the next succeeding volume of their Transactions, or in both.

9. The unsuccessful performances shall remain under consideration, and their authors be considered as candidates for the premium for five years next succeeding the time of their presentment; except such performances as their authors may, in the meantime, think fit to withdraw. And the Society shall annually publish an abstract of the titles, object, or subject matter of the communications, so under consideration; such only excepted as the Society shall think not worthy of public notice.

10. The letters containing the names of authors whose performances shall be rejected, or which shall be found unsuccessful after a trial of five years, shall be burnt before the Society, without breaking the seals.

11. In case there should be a failure, in any year, of any communication worthy of the proposed premium, there will then be two premiums to be awarded the next year. But no accumulation of premiums

shall entitle the author to more than one premium for any one discovery, invention or improvement.

12. The premium shall consist of an oval plate of solid standard gold of the value of ten guineas. On one side thereof shall be neatly engraved a short Latin motto suited to the occasion, together with the words: "The Premium of John Hyacinth de Magellan, of London, established in the year 1786;" and on the other side of the plate shall be engraved these words: "Awarded by the A. P. S. for the discovery of——A.D.——." And the seal of the Society shall be annexed to the medal by a ribbon passing through a small hole at the lower edge thereof.

SECTION 2. The Magellanic fund of two hundred guineas shall be considered as ten hundred and fifty dollars, and shall be invested separately from the other funds belonging to or under the care of the Society, and a separate and distinct account of it shall be kept by the treasurer.

The said fund shall be credited with the sum of one hundred dollars, to represent the two premiums for which the Society is now liable.

The treasurer shall credit the said fund with the interest received on the investment thereof, and, if any surplus of said interest shall remain after providing for the premiums which may then be demandable, said surplus shall be used by the Society for making publication of the terms of the said premium, and for such purposes as may be authorized by its charter and laws.

The treasurer shall, at the first stated meeting of the Society in the month of December annually, make a report of the state of said fund and of the investment thereof.